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PACIFIC SALMON COMMISSION

JOINT CHUM SALMON TECHNICAL COMMITTEE REPORT

REPORT TCCHUM (90)-1

FINAL 1988 POST SEASON SUMMARY REPORT

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INTRODUCTION

This Joint Chum Salmon Technical Committee report presents the appropriate information for 1988 chum salmon in southern British Columbia and Washington, as required in Chapter 6 of Annex IV of the Pacific Salmon Treaty (PST) (Attachment 1). Detailed information may be found in the Canadian and United States agency reports appended to this report (see Attachments 2 and 3).

STATUS OF TREATY REQUIREMENTS

Chum stocks and fisheries in southern B.C. and in U.S. areas 4B, 5, 6C, 7, and 7A are managed under the terms set out in the Pacific Salmon Treaty. The following provides a brief synopsis of the PST chum annex provisions (italics) and of Canadian and United States management actions in 1988.

1. *The Parties shall maintain a Joint Chum Technical committee to review stock status, develop new methods for stock management and report on management and research findings.*

   Reports published in 1988 are listed under 1988 Technical Committee Publications.

2. *Canada was to manage its Inside fisheries to provide rebuilding of depressed stocks and minimize increased interceptions of U.S. chum.*

   In 1988, the gross escapement of Inside chum totalled 1,669,000. Wild escapement totalled 1,480,000 which was 74% of the Clockwork goal of 2,000,000. The Fraser River wild escapement was 400,000 or 57% of the 700,000 goal. Although stock compositions samples were taken, the technical committee has not agreed on a method for determining whether increased interceptions were minimized.

   Terminal area fisheries scheduled by Canada to harvest specific stocks with identified surpluses included: mid Vancouver Island (Area 14), Nanaimo (Area 17), Cowichan (Area 18), Sooke (Area 20) and the Fraser River (Area 29). None of these fisheries were thought to increase interceptions of U.S. origin or other non-targeted stocks.

3. *In 1988, Canada was to manage its Johnstone Strait Clockwork harvest to set levels dependent on the run size entering Johnstone Strait as determined in-season.*

   The in-season estimate of Johnstone Strait run size was 4,153,000 providing for a harvest of 30% or 1,246,000 chum. At the end of the season, the overall harvest rate was 38.8% for clockwork assessment purposes and the run size was 3,138,000

chum. In 1988, the Clockwork Plan was revised to allow discrete management of the Fraser River terminal area fishery.

The harvest of chum salmon in U.S. fisheries 7 & 7A was limited to set catch ceilings dependent on the catch of chum salmon in Johnstone Strait. In addition, the proportion of effort and catch between Areas 7 & 7A was to be maintained

The total allowable catch for U.S. areas 7 & 7A was 140,000, however, this was reduced by a 6,000 chum overage from the U.S. fishery in 1987. The total catch for this fishery in 1988 was 130,000. The U.S. catch in Areas 7 and 7A was evenly divided between the two areas, which is the traditional proportion of catch between the two areas.

4. *In 1988, the U.S. was to maintain the limited effort nature of its chum fishery in U.S. Areas 4B, 5, and 6C to minimize increased interceptions of Canadian Chum. In addition, the U.S. was to monitor this fishery for increasing interceptions of Canadian chum.*

The U.S. chum fishery in the Strait of Juan de Fuca (Areas 4B, 5, and 6C) was limited, as it has been in past years, to participation by gillnet fishermen from the four Strait Tribes. It opened a week later than normal and closed in mid-November, as usual. The catch of 96,000 chum was the highest on record. GSI samples were taken to determine whether this large catch resulted in higher interception of Canadian chum.

5. *When the catch of chum salmon in U.S. Areas 7 & 7A fails to achieve the specified ceiling, the ceiling in subsequent years will be adjusted accordingly.*

The U.S. fishery in Areas 7 and 7A in 1988 fell 3,000 chum short of the 134,000 ceiling for 1988.

6. *Catch compositions in fisheries covered by this chapter were to be estimated post-season using methods agreed upon by the Joint Chum Technical Committee.*

Methods for estimating catch compositions in fisheries covered by this chapter are under review by the committee.

7. *In 1988, Canada was to manage the Nitinat net chum fishery to minimize the harvest of non-targeted stocks.*

The boundaries of the Nitinat fishery, in 1988, were extended an additional two miles offshore to increase the harvest of the large Nitinat return once escapement goals were achieved. Canada conducted GSI sampling to quantify the incidence of interceptions of passing stocks. The stock composition estimates of U.S. origin chum have not been finalized.

8. *In 1988, Canada was to conduct GSI sampling of the West Coast Vancouver Island troll fishery (Areas 121-124) if catch levels were predicted to reach levels similar to those in 1985 and 1986.*

Early season catch information from the West Coast Vancouver Island troll fishery did not indicate that the season's total chum catches would reach 1985/86 levels, as a result, Canada did not conduct GSI sampling of this fishery.

RUN SIZES

Southern British Columbia

The two areas of concern under the PST are those waters inside of Vancouver Island from Johnstone Strait to the southern portion of Vancouver Island (Inside) and those waters of the west coast of Vancouver Island (West Coast).

Inside Chum

The run size of fall chum salmon expected to return through Johnstone Strait was 4,089,000 of which 2,933,000 were predicted to be produced from Inside wild spawning areas, 1,056,000 from Inside enhancement facilities and 100,000 from Puget Sound. The size of the Fraser River component in the expected total run was estimated to be 1,850,000 chum, including 1,300,000 from wild spawning areas and 550,000 from enhancement facilities. The remaining wild spawning areas in the Inside area were expected to produce 1,633,000 chum salmon, while the remaining enhanced return, the majority of which originate from the mid Vancouver Island area, was expected to be 506,000.

The post-season Clockwork assessment of chum salmon, including Inside gross escapements, U.S. and Inside chum caught in Johnstone Strait and the Strait of Georgia, and the catch of Canadian chum in Areas 7 and 7A commercial fisheries, was 3,138,000 or 79% of the expected run size. The total return of Fraser River chum was 1,153,000 or 62% of the expected run size. The Fraser River run includes estimates of catches in U.S. and Canadian commercial, test and Indian food fisheries between the northern end of Vancouver Island and the Columbia River.

West Coast Chum

The expected return of Nitinat enhanced-origin chum salmon was 516,000. The return of chum salmon of wild origin to Nitinat was not predicted.

The postseason estimate of the run size of chum salmon of Nitinat origin was 1,636,000 including chum of enhanced and wild origin.

United States

The two regions to be reported under the PST are those waters along the U.S./Canada border from the outer Strait of Juan de Fuca to Point Roberts (including Puget Sound) and the waters along the outer coast of Washington State (Washington Coastal).

Puget Sound Chum

The total Puget Sound run size (all timing components) expected to return to Washington State waters was 1,929,000, which was the highest forecast since the beginning of the data base in 1968. Of these, 1,189,000 were expected from wild spawning areas and 741,000 were expected from enhancement facilities. The stocks that were expected to produce the largest returns were: south Puget Sound (478,000) and Hood Canal (719,000).

The post-season run size, as estimated from run reconstruction, was 2,039,000 chum which was 106% of the preseason forecast. This run size was the highest observed since the start of the data base in 1968, eclipsing the record return in 1987. Both enhanced and wild stocks in all regions showed very strong returns.

Washington Coastal Chum

On the Washington coast, chum salmon return in significant numbers to Grays Harbor and Willapa Bay. In addition, a small return of enhanced origin chum salmon occurs in the Quinault River. The 1988 preseason expected total run size of the Washington coastal chum salmon was 339,000. The actual return, as estimated by run reconstruction, was 379,000.

MANAGEMENT OF FISHERIES

Southern British Columbia

Inside Fisheries

Management of the fall chum salmon fisheries in Inside waters utilizes the Clockwork management strategy which combines stock assessment, harvest management, and allocation of catch.

The Clockwork is a variable harvest rate strategy directly tied to the size of the fall chum run passing through Johnstone Strait. This strategy was designed to permit limited fishing in most years while rebuilding the wild stock escapements. Maximum catch levels for Johnstone Strait are determined by applying the appropriate Clockwork

harvest rate to the estimated stock size. Fishing plans are designed to limit catches to this overall Clockwork allowable harvest.

Stock size assessment uses both commercial and test fishing information to estimate returning stock abundance. The initial in-season run size estimate is provided by a third week of September commercial assessment fishery. If the assessment indicates the fall chum run through Johnstone Strait exceeds 3 million, then further commercial harvesting will occur. Additional commercial harvesting in Johnstone Strait, that results in total catches exceeding 225,000, provides for directed chum harvests in U.S. Areas 7 and 7A.

In Johnstone Strait, the September stock size assessment fishery was conducted on September 13. A sockeye fishery in Area 29, during the same period, reduced the overall fishing effort and invalidated the assessment. A subsequent assessment fishery was conducted on September 20. Data from this fishery and subsequent test and commercial fisheries were used to derive run size estimates.

The Fraser River Chum Harvest Management Plan, formalized in 1988, dictates management of the Fraser River terminal fishery. Under this plan, past linkages with the Johnstone Strait Clockwork have been removed and harvests in the Fraser River are dependent on escapement to the river. A preliminary estimate of the run size of Fraser River chum is estimated from Johnstone Strait commercial assessment and test fishery data prior to the third week of October. Subsequent estimates of gross escapement to the river were determined from Fraser River test fishing data.

The Qualicum fishery is managed as a terminal fishery for mid Vancouver Island area enhanced chum salmon. Objectives include limiting the catch of local coho and chinook stocks, as well as limiting the catch of Fraser River chum. Genetic stock identification data were used during the season to determine stock composition.

West Coast Fisheries

The management of the Nitinat area fishery was planned to achieve the necessary escapements to both the wild spawning grounds and the hatchery. In addition, management plans included provisions for conducting fisheries at appropriate times and areas to ensure fleet safety and high product quality, as well as achieving domestic catch allocations between gear type.

Canada conducted genetic stock identification (GSI) sampling to quantify the incidence of interception of passing stocks in the Nitinat net fishery.

United States

The management objective for the Strait of Juan de Fuca (Areas 4B, 5, 6C) was to maintain the limited effort nature of the Treaty Indian fisheries through limiting the fishery to gillnet gear fishing five days per week. This fishery harvested primarily Puget Sound stocks. In 1988, Puget Sound coho management concerns delayed the opening of the chum fishery seven days.

In Areas 7 and 7A, the objective was to conduct fisheries at a level that would limit the total catch of chum to the appropriate level indicated in the PST. The U.S. managed its fisheries in Areas 7 and 7A for a quota of 134,000 chum, based on the PST quota of 140,000 and accounting for the 6,000 overage by the U.S. in 1987. An additional objective of the U.S. management in Areas 7 and 7A was to regulate the harvests between Treaty and non-Treaty fishermen to achieve domestic allocation.

REVIEW AND EVALUATION OF FISHERIES

Southern British Columbia

Inside chum

Chum salmon fishing occurred in Johnstone Strait (Areas 11 to 13), mid Vancouver Island (Area 14), Nanaimo (Area 17), Cowichan (Area 18) and Fraser River (Area 29). These fisheries, with the exception of Cowichan and the Fraser River, have the potential to harvest U.S. origin chum incidentally during harvests directed at Canadian origin chum.

Two commercial fisheries occurred in Johnstone Strait in addition to the assessment fisheries conducted during September. The total Johnstone Strait fall chum catch was 1,080,000. Summer run catches in Johnstone Strait were 49,700 chum and are not included in the Clockwork calculations.

As a result of the large catch of mid Vancouver Island stocks in the Johnstone Strait fishery, the mid Vancouver Island early fishery was limited to two weeks of harvesting by gillnet gear. The total Area 14 catch was 39,000 chum. The one-day Nanaimo area fishery harvested 23,200 chum; the Cowichan area catch of 56,000 chum was harvested during three weeks of commercial gillnet fishing.

A one day Fraser River PSC controlled fishery on October 4 for sockeye harvested 32,000 chum. One subsequent fishery was permitted under Fraser River Chum Management on October 19 which harvested 42,600 chum.

West Coast Chum

Nitinat fisheries commenced on September 26 and continued weekly until November 14, with a closure from October 30 to November 5. Fishing times alternated between gill net and purse seines with a total catch of 1,795,000 chum. During the fishery, the Nitinat fishing area was expanded offshore an additional two miles to increase the harvest of the large Nitinat return once escapement goals were achieved. A one day terminal fishery in Area 20 adjacent to the Sooke River harvested 11,000 chum.

The West coast troll fishery (Areas 1-21 to 1-27) harvested 80,000 chum salmon in July and August. Past analysis has indicated that the majority of this catch is Canadian summer run stocks.

United States

The major fisheries intercepting Canadian origin chum salmon in the U.S. are in the Strait of Juan de Fuca (Areas 4B, 5, 6C), San Juan Islands (Area 7) and Point Roberts (Area 7A). A significant proportion of the chum catch in these fisheries is currently believed to be of Canadian origin.

Gill net fisheries in Areas 4B, 5, and 6C occurred from October 9th into mid-November with a total of 95,800 chum caught by Treaty Indians in these areas. This was higher than previous years' catch in this fishery. The commercial catch of chum in Areas 7 and 7A totalled 129,900. Of these, 18,900 were taken in PSC controlled fisheries prior to fall chum management. Two days of chum fishing by Treaty Indians and one day by non-treaty fishermen October 14 through 18 caught 84,600 chum. Additional non-treaty fishing in November took 26,400 chum.

ESCAPEMENT

Southern British Columbia

Inside Chum

Total fall chum salmon gross escapement was 1,669,000. The wild spawning escapement of 1,480,000 was 74% of the Clockwork interim escapement goal of 2 million, but larger than the 1987 escapement. The wild spawning escapement of 1,480,000 was 93% of the 1983-87 average wild escapement and achieved 57% of the identified overall spawning ground capacity. The only area which achieved the target escapement goal was Loughborough/Bute Inlet. The total Fraser River escapement was 57% of the spawning goal and accounted for 27% of the total inside fall chum escapement.

West Coast Chum

The Nitinat total escapement of chum salmon was 256,800 of which 241,800 spawned in the wild spawning areas meeting the escapement objective of 200,000 chum. The Nitinat Hatchery eggtake was 3 million below the 23 million goal due to pre-spawning mortality caused by a turnover of Nitinat Lake.

United States

Puget Sound Chum

The Puget Sound chum salmon escapement of 620,400 was the largest escapement recorded since the start of the data base in 1968. The largest escapement increases of normal timed (fall) stocks occurred in two of the six regions: the South Puget Sound and the Stillaguamish/Snohomish systems. Early timed (summer) chum escapements in the Strait of Juan de Fuca, South Puget Sound and Hood Canal were at or above their expected escapements, as were South Puget Sound late timed (winter) chum stocks.

Washington Coastal Chum

The wild chum escapements in Willapa Bay, Grays Harbor and the Quinault River totalled 131,700, 230% above the expectation of 56,900.

REVIEW OF GSI PROGRAMS

The Canadian chum salmon fishery areas sampled for GSI data included Johnstone Strait (Area 12) test fisheries, mid Vancouver Island (Qualicum, Area 14) Nitinat (Area 21) and Nanaimo (Area 17) commercial fisheries. A total of 5,876 samples were taken in 1988.

The West coast of Vancouver Island troll fishery sampling program was cancelled due to low chum troll catches and difficulties in obtaining samples (Areas 21-27). Catches did not reach 1985 or 1986 levels.

The GSI samples collected in U.S. waters were from commercial and test fisheries in the San Juan Islands and Point Roberts (Areas 7 & 7A) and the Strait of Juan de Fuca (Area 5). Further baseline samples are currently being incorporated and results will be available in 1990.

In addition, a GSI subcommittee continued its task of reviewing and reconciling differences in approach to GSI by Canada and the U.S. The GSI subcommittee work is expected to be completed in early 1990.

1988 TECHNICAL COMMITTEE PUBLICATIONS

TCCHUM (88)-1 Historical Canadian and United States Chum Salmon Data Report for the Years Prior to 1985.

TCCHUM (88)-2 Progress Report on Genetic Stock Identification of Chum Salmon in Southern British Columbia and Washington.

TCCHUM (88)-3 Summary Report on the Current and Future Management and Enhancement Intentions of the United States and Canada for Southern Chum Salmon.

TCCHUM (88)-4 Final 1987 Post Season Summary Report

ATTACHMENT 1

CHAPTER 6 OF ANNEX IV OF THE PACIFIC SALMON TREATY

1988 CHAPTER

Chapter 6

SOUTHERN BRITISH COLUMBIA AND WASHINGTON STATE CHUM SALMON

1. The Parties shall maintain a Joint Chum Technical Committee (Committee) reporting, unless otherwise agreed, to the Southern Panel and the Commission. the Committee, inter alia, will undertake to

   (a) identify and review the status of stocks of primary concern;

   (b) present the most current information on harvest rates and patterns on these stocks, and develop a joint data base for assessments;

   (c) collate available information on the productivity of chum stocks to identify escapements which produce maximum sustainable harvests and allowable harvest rates;

   (d) present historical catch data, associated fishing regimes, and information on stock composition in fisheries harvesting those stocks;

   (e) devise analytical methods for the development of alternative regulatory and production strategies;

   (f) identify information and research needs, to include future monitoring programs for stock assessment; and,

   (g) for each season, make stock and fishery assessments and evaluate the effectiveness of management.

2. In 1988, Canada will manage its Johnstone Strait, Strait of Georgia, and Fraser River chum fisheries to provide continued rebuilding of depressed naturally spawning chum stocks, and, to the extent practicable, minimize increased interceptions of United States origin chum. Terminal fisheries conducted on specific stocks with identified surpluses will be managed to minimize interception of non-targeted stocks.

3. In 1988,

   (a) for Johnstone Strait run sizes less than 3.0 million

      (i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will limit its harvest rate in Johnstone strait to less than 10 percent, resulting in a Johnstone Strait catch level of up to 225,000 chum; and,

      (ii) when the catch in Johnstone Strait is 225,000 chum or less, the United States catch of chum in Areas 7 and 7A shall be limited to chum taken incidentally to other species and in other minor fisheries, but shall not exceed 20,000, provided, however, that catches for the purposes of electrophoretic sampling shall not be included in the aforementioned limit;

(b) for Johnstone Strait run sizes from 3.0 million to 3.7 million

(i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will limit its harvest rate in Johnstone Strait to 20 percent, resulting in a Johnstone Strait catch level of 225,000 to 640,000 chum; and,

(ii) when the catch in Johnstone Strait is from 225,000 to 640,000 chum, the United States catch of chum in Areas 7 and 7A shall not exceed 120,000;

(c) for Johnstone Strait run sizes of 3.7 million and greater

(i) Canada, taking into account the catch of Canadian chum in United States Areas 7 and 7A, will harvest at a rate in Johnstone Strait of 30 percent or greater, resulting in a Johnstone Strait catch level of 640,000 chum or greater; and,

(ii) when the catch in Johnstone Strait is 640,000 chum or greater, the United States catch of chum in Areas 7 and 7A shall not exceed 140,000;

(d) it is understood that the Johnstone Strait run sizes, harvest rates, and catch levels referred to in 3(a), 3(b), and 3(c) are those determined in season, in Johnstone Strait, by Canada; and,

(e) the United States shall manage in a manner that, as far as practicable, maintains a traditional proportion of effort and catch between United States Areas 7 and 7A, and avoids concentrations of effort along the boundary in Area 7A.

4. In 1988, the United States shall conduct its chum fishery in the Strait of Juan de Fuca (United States Areas 4B, 5 and 6C) so as to maintain the limited effort nature of this fishery, and, to the extent practicable, minimize increased interceptions of Canadian origin chum. The United States shall continue to monitor this fishery to determine if recent catch levels indicate an increasing level of interception.

5. If the United States chum fishery in AReas 7 and 7A fails to achieve the 1988 catch levels specified in paragraphs 3(a)(ii), 3(b(ii), and 3(c)(ii), any differences shall be compensated by adjustments to the Areas 7 and 7A fishery in subsequent years, except that chum catches below the level specified in paragraph 3(a)(ii) shall not be compensated.

6. Catch compositions in fisheries covered by this chapter will be estimated by post-season analysis using methods agreed upon by the Joint Chum Technical Committee.

7. Canada will manage the Nitinat net chum fishery to minimize the harvest of non-targeted stocks.

8. In 1988, Canada shall conduct electrophoretic sampling of chum taken in the West Coast Vancouver Island troll fishery if early-season catch information indicates that catch totals for the season may reach levels similar to 1985 and 1986. Sampling, should it occur, will include catches taken form the southern areas (Canadian Areas 121-124).

ATTACHMENT 2

FINAL 1988 POST SEASON SUMMARY REPORT ON

CHUM SALMON

UNITED STATES AGENCY REPORT

REVIEW OF 1988 WASHINGTON CHUM SALMON FISHERIES

I. INTRODUCTION

This report was prepared by the United States (U.S.) section of the joint chum technical committee formed under provisions of the Pacific Salmon Treaty. It provides a general overview of the 1988 chum salmon fisheries in Washington State and a more detailed review of those fisheries that intercept Canadian origin chum salmon.

The fisheries in Washington State waters that are believed to harvest significant numbers of southern British Columbia origin chum salmon are those in the western Strait of Juan de Fuca (areas 4B,5,6C), the San Juan Islands (Area 7) and Point Roberts (Area 7A). The majority of the harvest in areas 4B,5,6C is of U.S. origin; consequently, management objectives in these areas are based primarily on the needs of stocks originating in Puget Sound. The chum fishery in these areas has been restricted in recent years to a limited Treaty Indian gillnet fishery. The harvest in areas 7 and 7A is primarily chum salmon of Canadian origin and in recent years has been managed to meet the obligations of the treaty. Additional U.S. fishing areas that could potentially contain chum salmon of Canadian origin include the eastern Strait of Juan de Fuca (Area 6) and West Beach (Area 6A). Both of these areas remained closed to directed chum fishing in 1988 and little or no chum catch occurred.

Other Puget Sound and Washington coastal fisheries are primarily terminal fisheries targeted on a specific stock or group of stocks, with little or no interception of non-target stocks.

II. MIXED STOCK FISHERIES (Strait of Juan de Fuca, San Juan Islands and Point Roberts)

A. MANAGEMENT STRATEGY

The 1988 management strategy in areas 4B, 5 and 6C remained basically unchanged from recent years, and was consistent with the requirements of the chum annex of the Pacific Salmon Treaty. The fishery was restricted to Treaty Indian gillnet gear fishing a 5 day per week schedule. Due to weak coho returns to some Puget Sound rivers, the Strait fishery was delayed beyond the beginning of the chum management period (October 2), and did not open until October 9th. It was planned for the fishery to continue at a 5 day per week schedule until mid-November when catches and effort drop off and the fishery is closed.

The management regime for areas 7 and 7A was established by the Pacific Salmon Commission at their February 1988 meeting. The agreement called for the fishery in these areas to be managed on the basis of catch levels that occur in the Canadian fishery in Johnstone Strait (based on the Clockwork management plan). The 1988 regime called for an area 7/7A ceiling of 20,000 chum if the total chum catch in Johnstone Strait was less than 225,000 (10% harvest rate); a ceiling of 120,000 chum if the total Johnstone Strait catch was between 225,000 and 640,000 (20% harvest rate); and a ceiling of 140,000 chum if the Johnstone Strait catch was greater than 640,000 (30% or greater harvest rate). The annex also required the U.S. to attempt to maintain a traditional proportion of effort and catch between areas 7 and 7A.

Fishery Review

The chum management period for areas 4B, 5 and 6C began October 2nd. Catches of chum taken incidental to sockeye and pink fisheries, prior to October 2nd, totalled 347. Chum fishing was delayed until October 9th, due to concerns for weak Puget Sound wild coho stocks. Catches in the Strait were about as expected throughout the chum management period, except for the third week of the fishery (10/24 - 10/28). Catch per landing statistics for this period were higher than observed in any previous year. Catches and effort dropped off to very low levels after the first week of November. The total commercial catch of chum for the season in the Strait of Juan de Fuca was 95,828 (Table 1).

Chum harvests in areas 7 and 7A occurred in both directed coho and chum fisheries. Treaty Indian coho directed fisheries occurred for one day on October 3 and 4, and again for one day on October 7 and 8. These fisheries incidentally harvested 16,662 chum salmon. A non-treaty reef net fishery occurred for coho from September 19 through October 10, and incidentally harvested 1,966 chum salmon. The total chum catch prior to chum management was 18,918.

Throughout the chum season, U.S. and Canadian technical staffs kept in close contact on the status of the chum run size entering Johnstone Strait. Initial indications were that the run was smaller than expected and may not allow a directed fishery. However, after the first week of October, test fishing catches in Johnstone Strait improved and DFO notified Washington managers on October 12 that they were forecasting a run size larger than 3.2 million, and were opening a fishery that would raise the total Johnstone Strait catch above 225,000. This allowed the U.S. fishery in areas 7 and 7A to proceed to a harvest level of 120,000 chum.

Based on the 120,000 fish ceiling, a treaty Indian fishery was scheduled from October 14 to October 16 (2 days), which harvested 40,051 chum. This was followed by a non-treaty fishery on October 18 (one day) which harvested 44,517 chum. These fisheries brought the total areas 7 and 7A chum catch to 103,486.

DFO notified Washington managers on October 18 that they had very good catches in Johnstone Strait the previous week and had decided to upgrade the run size to over 4

million. Based on this information, and the total catch in Johnstone Strait, the ceiling in areas 7 and 7A became 140,000. However, the target catch for this fishery was adjusted down to 134,000 to account for the U.S. overage of 6,000 chum in 1987. Additional non-treaty fisheries were conducted throughout the month of November. Catches were poor during this time period and the harvest ceiling was not fully achieved. The chum catch in areas 7 and 7A for the season was 129,886 commercial catch, plus 1,470 chum taken in test fisheries to collect GSI samples for a total of 131,356. This leaves 2,644 of the 1988 ceiling unharvested even after adjusting for the 1987 overage.

II. PUGET SOUND INSIDE FISHERIES

A. PRE-SEASON EXPECTATIONS

Management of Puget Sound chum salmon fisheries attempts to achieve fixed spawner escapement goals for natural and/or hatchery returns to each production unit of Puget Sound. Domestic allocations are established for harvestable surpluses returning to six broad regions of origin. Although management within a region addresses the escapement objectives of one or more specific stocks, Puget Sound fishery descriptions in this report provide only a brief overview of regional management strategies.

The preparation of annual management plans, including pre-season run size forecasts and management recommendations, is developed for Puget Sound according to the Puget Sound Salmon Management Plan (PSSMP). This plan specifies a schedule for the Washington Department of Fisheries (WDF) and the Treaty Tribes to develop and exchange methodologies and recommendations on pre-season forecasts, escapement goals and other aspects of pre-season management planning. The planning efforts are documented in a published report each season.

The pre-season expectation of abundance for 1988 Puget Sound origin chum salmon of all timing components was 1,929,900, of which 1,188,700 were expected to be of natural origin and 741,200 were expected to be of enhanced origin (Table 2). This was the highest run size forecast since the beginning of the data base in 1968, and a substantial improvement over the previous run sizes in the 1972-76-80-84 cycle, which have averaged 1,004,500.

B. FISHERIES DESCRIPTIONS, CATCHES AND SPAWNING ESCAPEMENTS

The actual return of 2,039,400 was 106% of the pre-season forecast and was a record return to Puget Sound for the third year in a row. It represented an increase of 278,000 over the 1987 return and 507,000 over the 1986 return. Most of the increase resulted from the very large natural runs returning to the Stillaguamish/Snohomish and South Puget Sound regions, and the large hatchery run returning to Hood Canal. The total Puget Sound escapement of 620,400 chum was the largest escapement since the start of the data base in 1968.

A summary of the pre-season forecasts, final in-season updates of abundance, final 1988 run sizes, and escapements is presented in Table 2. Additional information on each stock is available through the Puget Sound run reconstruction reports. These run size estimates do not include Canadian harvests of U.S. origin chum or catches (from both commercial and test fisheries) in U.S. waters of Canadian origin chum salmon. A total of 146,806 Canadian chum were estimated as being caught in Washington fisheries using the proportions in Table 8. Of these, 38,219 were caught in areas 4B/5/6C and 108,587 in areas 7 and 7A. Detailed information on chum harvests in each Puget Sound catch area is provided in Table 4. A comparison of 1985 through 1988 total Puget Sound run sizes and escapements is provided in Table 9. The following is an overview of stock status and management actions for each of the six Puget Sound regions of origin.

Strait of Juan de Fuca Tributaries

Chum salmon from Strait of Juan de Fuca tributaries are of primarily natural origin and consist of two run timings: early and normal. The early stock return of 2,800 was 51% above the forecast, and the normal timed stock return of 12,000 was 11% below the forecast. Spawning escapements for both stocks exceeded the escapement goals. Terminal catches were minor, and increased effort continues to be devoted to determining the amount and extent of spawning in individual streams.

Nooksack/Samish Region

The chum return, largely of natural origin, of 100,400 was 42% below the pre-season expectations, but was only 5% below the in-season run size update, thus providing an accurate estimate for management purposes. The spawning escapement goal for this system was exceeded.

Skagit Region

The chum return to Skagit was 169,700, which was almost exactly the pre-season forecast of 165,300. Spawning escapement was 119,800, slightly exceeding the goal of 116,500.

Stillaguamish/Snohomish Region

Chum salmon from this region are all of normal timing, and are predominantly of natural origin. The chum return of 477,100 was the largest return on record for the region and was 26% larger than the pre-season forecast of 378,100. This return was also 57% larger than the in-season estimate of run size of only 303,500. This resulted in an underharvest and an escapement of 149,000, exceeding the goal of 61,000.

South Puget Sound Region

This region supports early, normal and late timed chum. The early and late chum are largely natural origin. The majority of the normal timed chum are also of natural origin, with some hatchery production. Returns of all three components greatly exceeded pre-

season expectations, and resulted in good spawning escapement levels. The early timed return of 100,400 was 71,900 above the forecast and was the largest return of early chum since 1972, resulting in an escapement of 31,400, approximately achieving the goal of 32,800.

The normal timed return was 477,700, the largest observed for this region since the beginning of the data base in 1968. This return was 27% of the pre-season forecast, but 9% below the in-season run size update. Commercial catches were excellent, and the escapement objective was exceeded.

The late timed return of 97,000 was 33% above the pre-season forecast of 72,850, but below the in-season run size estimate of 117,500. The spawning escapement was 43,900, which exceeded the goal of 30,300.

Hood Canal Region

Hood Canal supports stocks of early and normal timed chum salmon. The normal timed chum are predominantly of hatchery origin. The normal timed segment was 596,200, and was significantly below the pre-season forecast of 715,300. The in-season update of run strength was 590,600, very close to the actual run size and resulted in good commercial fisheries and an escapement of 93,900, very close to the escapement goal of 90,400.

6,100 early timed chum returned to Hood Canal exceeding the pre-season forecast by 90%. This return resulted in a spawning escapement of 3,400, which was greater than expected.

Areas 6B and 9

Admiralty Inlet (Area 9) is a mixed stock fishing area containing stocks originating primarily from three regions of origin: Hood Canal, South Puget Sound and Stillaguamish/Snohomish. Fisheries are scheduled infrequently in this area as harvestable numbers are seldom available for each of the supporting stocks after terminal area run size updates are available. In-season verification of the run strengths for the stocks returning to the three regions of origin is usually desired before scheduling fisheries in areas 6B or 9. However, in 1988 the pre-season forecast was for a record chum return providing a reasonable assurance that harvestable fish would be available from all three regions.

A one day treaty Indian fishery occurred in area 9, under limited hours, on October 19, and harvested 61,962. This catch was three times higher than expected and no additional fisheries were scheduled.

IV Washington Coastal Fisheries

The 1988 coastal chum returns to both Willapa Bay and Grays Harbor were excellent. Other Washington coastal rivers have few returning chum salmon and no significant catches except for the Quinault River which has a small return, primarily of hatchery origin. Pre-season forecasts, actual run sizes, catches, and escapements for Washington coastal stocks are given in Table 5.

Willapa Bay

The pre-season prediction was for a return of 162,000 wild and 37,800 hatchery fish to Willapa Bay, the highest chum return in recent history. The actual return of 225,200 was about 12% greater than the pre-season estimate. The gillnet catch of 147,800 fish combined with an estimated sport catch of 1,000 fish resulted in a harvest rate of 66%. This compares to the previous ten year average gillnet catch of 37,200 and average total run size of 76,800. The gillnet catch amounted to about 1,571,000 pounds at an average weight of 10.6 pounds per fish.

As a note,however, the relative fish age class strength in these returns indicated a near failure of the three year old age group. The composition was less than 2% three, about 95% four, and about 4% five year old fish. On average, three year olds should comprise about a third of the return. As such, this may indicate a relatively poor return of four year old fish in 1989.

Chum salmon are managed entirely for natural escapement in Willapa Bay. The natural chum escapement was 75% above the goal. Good distribution was seen in most areas. Stream flows were moderate to high and provided for good spawning conditions. Age composition information indicated, however, a strong return of four and five year old fish and near failure in the return of three year old fish.

Grays Harbor

The pre-season prediction was for 130,000; the highest return in recent history, nearly all wild stock. The in-season update supported a strong run prediction but indicated a return about 40% lower. Within the limitations of incidental harvests of other stocks and escapement needs, large chum harvests were expected.

The actual return estimate is about 136,300 chum near the pre-season expectation and greater than the in-season update. This is about 2.3 times the previous ten-year average and the largest return for the period. Grays Harbor commercial fisheries took 72,144 fish, a harvest rate of 53% of the return. This is 2.2 times the previous ten-year average and the highest for the period. Non-treaty, Quinault Treaty and Chehalis fisheries each respectively took 41,333, 30,477, and 334 chum. For non-treaty and Quinault fishermen this represented catches more than twice their previous ten-year average and their highest for the period. Chehalis Tribe catches were very restricted by wild coho interceptions and were only half of their average for the previous ten years. The total chum commercial catch was 834,348 pounds at an average weight of 11.6 pounds per fish.

Coincident with the high run size, chum escapements were well above goal and the highest for the previous ten years. Both good distribution and good utilization of tributary areas was achieved. As a note, however, there was a very low proportion of three year old fish in the return. As such, returns of this year class as fours in 1989 and fives in 1990 are also expected to be depressed.

Quinault

Chum salmon returning to the Quinault River are almost entirely of hatchery origin, although significant straying to wild spawning areas occurs. The return to the Quinault in 1988 was also well above pre-season prediction. The run size was 17,500 of which 8,600 were caught in the Treaty Indian net fishery. The total escapement was 8,900 with 1,300 returning to the Quinault National Fish Hatchery and 7,600 that strayed to wild spawning areas.

V. STOCK COMPOSITION AND RUN RECONSTRUCTION

During 1988, Puget Sound genetic stock identification (GSI) studies of chum salmon consisted of collecting replicate and additional baseline samples from Washington and Canadian stocks (Table 6) as well as samples for stock composition analysis from test and commercial fisheries in mixed stock areas in northern Puget Sound and the Strait of Juan de Fuca (Table 7).

The 1988 sampling design in areas 7 and 7A was modified from previous years to improve sampling of commercial fisheries and to increase sample size. The sample sizes were increased in areas 7 and 7A to 400 samples per week to increase the precision and accuracy of stock composition estimates. A priority was placed on sampling commercial fisheries and conducting test fishing at Point Roberts when commercial fishing was closed. Test fishing was also conducted in area 7 at the Salmon Banks during October when commercial fishing was closed. The test sampling at Lummi Island was discontinued. There was also an attempt to oversample the commercial fisheries and to separate samples by gear type. This was intended to allowed the 400 samples for analysis to be selected to represent the proportions of the catch by gear type.

All 1988 fishery samples were assayed for 25 loci. The Chum Technical Committee is continuing its investigations into the usefulness of increasing the number of loci for GSI analysis.

TABLE 1. 1988 COMMERCIAL CHUM HARVEST IN SELECTED PUGET SOUND CATCH REPORTING AREAS.*

Areas	Opening/ Week	Indian GN	Indian PS	Indian Total	Non-Indian GN	Non-Indian PS	Non-Indian RN	Non-Indian Total	Grand Total
Area 7A	10/3 - 10/4 **	841	805	1,646					
	10/7 - 10/8 **	2,710	3,220	5,930					
	10/14 - 10/16	17,478	938	18,416					
	10/18				19,308	7,319	0	26,627	
	11/7 - 11/9				11,355	647	0	12,002	
	11/17 - 11/18				704	472	0	1,176	
Area 7A Total		21,029	4,963	25,992	31,367	8,438	0	39,805	65,797
Area 7	9/19 - 10/10 **						1,966	1,966	
	10/3 - 10/4 **	596	2,031	2,627					
	10/7 - 10/8 **	1,567	4,892	6,459					
	10/14 - 10/16	4,416	17,219	21,635					
	10/18				13,915	3,925	50	17,890	
	11/7 - 11/9	116			5,147	4,060	0	9,207	
	11/17 - 11/18				2,739	1,276	0	4,015	
Area 7 total		6,695	24,142	30,721	21,801	9,261	2,016	33,078	63,799
Areas 7/7A total									129,596
Areas 4B, 5 and 6C	prior to 10/9	347							
	10/9 - 10/15	21,440							
	10/16 - 10/22	10,969							
	10/23 - 10/29	42,552							
	10/30 - 11/5	19,399							
	11/6 - 11/12	579							
	After 11/13	542							
Areas 4B, 5 and 6C total		95,828							

* - Prelininary data. Does not include 290 chum taken in areas 7/7A prior to 10/3 and 1,470 chum taken in test fisheries.
** - Incidental chum catch during a directed coho fishery.

Table 2. Summary of 1988 Puget Sound chum salmon management information by region of origin (using run reconstruction).

Region	Preseason Forecast	Final Inseason Update	Final Run Size	Escapement Expectation	Observed Escapement
Strait of Juan de Fuca					
Early	1,850	1,850	2,809	1,800	2,802
Normal	13,400	13,770	11,957	12,200	10,994
Nooksack/Samish	174,420	105,520	100,369	29,100	39,473
Skagit River	165,340	134,450	169,691	116,500	119,869
Stillaguamish/Snohomish	378,100	303,540	477,105	74,600	154,424
South Puget Sound					
Early	28,490	28,490	100,431	20,800	37,002
Normal	376,920	524,070	477,712	95,500	114,650
Late	72,850	117,490	97,031	30,900	43,941
Hood Canal					
Early	3,200	3,200	6,071	1,200	3,386
Normal	715,300	590,570	596,238	92,600	93,875
Total	1,929,870	1,822,950	2,039,414	475,200	620,416

Source: WDF, Puget Sound Indian Tribes and NWIFC, 1988 Puget Sound Chum Salmon Forecasts and Management Recommendations. WDF Stock Strength Calculation Summary (5/23/89).

Table 3. Final 1988 Puget Sound chum salmon run size estimates

Region	Production	Early	Normal	Late	Total
Strait of Juan de Fuca	Natural	2,809	11,957		14,766
	Hatchery				0
Nooksack/Samish	Natural		93,413		93,413
	Hatchery		6,956		6,956
Skagit River	Natural		169,581		169,581
	Hatchery		110		110
Stillaguamish/Snohomish	Natural		369,040		369,040
	Hatchery		108,065		108,065
South Puget Sound	Natural	85,243	403,197	95,583	584,023
	Hatchery	15,188	74,515	1,448	91,151
Hood Canal	Natural	6,071	166,558		172,629
	Hatchery		429,680		429,680
Total		109,311	1,833,072	97,031	2,039,414

	Early	Normal	Late	Total
Natural	94,123	1,213,746	95,583	1,403,452
Hatchery	15,188	619,326	1,448	635,962
Total	109,311	1,833,072	97,031	2,039,414

Region	Early	Normal	Late	Total
Strait of Juan de fuca	2,809	11,957		14,766
Nooksack/Samish		100,369		100,369
Skagit River		169,691		169,691
Stillaguamish/Snohomish		477,105		477,105
South Puget Sound	100,431	477,712	97,031	675,174
Hood Canal	6,071	596,238		602,309
Total	109,311	1,833,072	97,031	2,039,414

Source: WDF Stock Strength Calculation Summary (5/23/89).
Off-station plant returns have been included with hatchery returns.

Table 4.

WASHINGTON STATE DEPARTMENT OF FISHERIES 12/04/89

CHUM SALMON COMMERCIAL CATCH - PUGET SOUND AREAS

CUMULATIVE CATCH IN NUMBERS OF FISH DATE RANGE USED - 1/ 1/88 TO 12/31/88

AREA CODE	ABBREVIATED AREA NAME	INDIAN GILLNET	SETNET	PURSE SEINE	BEACH SEINE	OTHER GEAR	TROLL	SUB-TOTAL	NON-INDIAN GILLNET	PURSE SEINE	OTHER GEAR	TROLL	SUB-TOTAL	AREA TOTAL
4B	MARINE 4B	35	0	0	0	0	5	40	0	0	0	0	0	40
5	MARINE 5	77446	0	0	0	0	165	77611	3	0	0	0	3	77614
6C	MARINE 6C	18367	0	0	0	0	0	18367	0	0	0	0	0	18367
***	SUB-TOTAL	95848	0	0	0	0	170	96018	3	0	0	0	3	96021
6	MARINE 6	47	0	0	0	0	0	47	33	0	0	0	33	80
6A	MARINE 6A	0	0	0	0	0	0	0	0	0	0	0	0	0
7	MARINE 7	6723	0	24923	0	0	0	31646	21989	9286	2019	0	33294	64940
7A	MARINE 7A	21610	0	4963	0	0	0	26573	31374	8469	0	0	39843	66416
6D	MARINE 6D	57	0	0	0	0	0	57	69	0	0	0	69	126
74B	SAIL RIVER	1	0	0	0	0	0	1	0	0	0	0	0	1
75A	CLALLAM RV	20	0	0	0	0	0	20	0	0	0	0	0	20
75B	DEEP CREEK	0	0	0	0	0	0	0	0	0	0	0	0	0
75C	HOKO RIVER	44	0	0	0	0	0	44	0	0	0	0	0	44
75D	LYRE RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0
75E	PYSHT RVR	132	0	0	0	0	0	132	0	0	0	0	0	132
75F	SEKIU RVR	18	0	0	0	0	0	18	0	0	0	0	0	18
75G	TWIN RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0
76A	DUNGENESS	0	0	0	0	0	0	0	0	0	0	0	0	0
76B	ELWHA RVR	269	0	0	0	0	0	269	0	0	0	0	0	269
76C	MORSE CRK	0	0	0	0	0	0	0	0	0	0	0	0	0
76D	SALT CREEK	0	0	0	0	0	0	0	0	0	0	0	0	0
***	SUB-TOTAL	541	0	0	0	0	0	541	69	0	0	0	69	610
7B	MARINE 7B	19146	0	420	0	0	0	19566	12289	1273	0	0	13562	33128
77B	UPP.NOOKSC	23197	0	0	0	0	0	23197	0	0	0	0	0	23197
77C	LOW.NOOKSC	0	0	0	0	0	0	0	0	0	0	0	0	0
7C	MARINE 7C	0	0	0	0	0	0	0	0	0	0	0	0	0
77D	SAMISH RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
7D	MARINE 7D	41	0	0	0	0	0	41	0	0	0	0	0	41
7E	MARINE 7E	7	0	0	0	0	0	7	0	2	0	0	2	9
77A	CALIF. CRK	0	0	0	0	0	0	0	0	0	0	0	0	0
77G	DAKOTA CRK	0	0	0	0	0	0	0	0	0	0	0	0	0
***	SUB-TOTAL	42391	0	420	0	0	0	42811	12289	1275	0	0	13564	56375
8	MARINE 8	20979	0	0	0	0	0	20979	8075	1297	0	0	9372	30351
78B	SAUK RIVER	0	0	0	0	0	0	0	0	0	0	0	0	0
78C	LOW.SKAGIT	12055	0	0	0	0	0	12055	0	0	0	0	0	12055
78D	UPP.SKAGIT	0	0	0	0	0	0	0	0	0	0	0	0	0
***	SUB-TOTAL	33034	0	0	0	0	0	33034	8075	1297	0	0	9372	42406
6B	MARINE 6B	0	0	0	0	0	0	0	0	0	0	0	0	0
9	MARINE 9	33998	0	29573	0	0	0	63571	232	0	0	0	232	63803
***	SUB-TOTAL	33998	0	29573	0	0	0	63571	232	0	0	0	232	63803
8A	MARINE 8A	97439	0	0	3007	0	0	100446	47376	80945	0	0	128321	228767
78F	SNOHOMISH	0	0	0	0	0	0	0	0	0	0	0	0	0
78G	STILLAGUAM	11996	0	0	0	0	0	11996	0	0	0	0	0	11996
8D	MARINE 8D	33276	0	0	3232	0	0	36508	1813	3243	0	0	5056	41564
***	SUB-TOTAL	142711	0	0	6239	0	0	148950	49189	84188	0	0	133377	282327
10	MARINE 10	11628	0	24325	3	0	0	35956	91627	75867	0	0	167494	203450
10A	MARINE 10A	2993	0	0	0	0	0	2993	0	0	0	0	0	2993
80B	DUWA-GREEN	1139	0	0	0	0	0	1139	0	0	0	0	0	1139
10B	LK.WA. 10B	0	0	0	0	0	0	0	0	0	0	0	0	0
10C	LK.WA. 10C	0	0	0	0	0	0	0	0	0	0	0	0	0
80A	CEDAR RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
10D	LK.SA. 10D	0	0	0	0	0	0	0	0	0	0	0	0	0
10E	MARINE 10E	21843	0	0	0	0	0	21843	0	0	0	0	0	21843
10F	LK.UN. 10F	178	0	0	0	0	0	178	0	0	0	0	0	178
10G	LK.WA. 10G	89	0	0	0	0	0	89	0	0	0	0	0	89
11	MARINE 11	9771	0	0	17	0	0	9788	19161	46415	0	0	65576	75364
11A	MARINE 11A	234	0	0	0	0	0	234	0	0	0	0	0	234
81A	CARBON RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
81B	PUYALLUP R	11650	0	0	0	0	0	11650	0	0	0	0	0	11650
81C	WHITE RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
13	MARINE 13	819	0	0	21	0	0	840	81	0	0	0	81	921
83D	NISQUALLY	55301	0	0	0	0	0	55301	0	0	0	0	0	55301
83F	MCALLISTER	449	0	0	0	0	0	449	0	0	0	0	0	449
13A	MARINE 13A	14855	0	428	827	0	0	16110	0	0	0	0	0	16110
83C	MINTER CRK	0	0	0	0	0	0	0	0	0	0	0	0	0
83E	PUROY-CASE	0	0	0	0	0	0	0	0	0	0	0	0	0
13B	MARINE 13B	0	0	0	0	0	0	0	0	0	0	0	0	0
13C	MARINE 13C	86	0	0	0	0	0	86	0	0	0	0	0	86
83H	CHAMBERS C	0	0	0	0	0	0	0	0	0	0	0	0	0
13D	MARINE 13D	21593	0	0	2427	0	0	24020	0	0	0	0	0	24020
13E	MARINE 13E	0	0	0	0	0	0	0	0	0	0	0	0	0
13F	MARINE 13F	15	0	0	0	0	0	15	0	0	0	0	0	15
83A	DESCHUTES	0	0	0	0	0	0	0	0	0	0	0	0	0
13G	MARINE 13G	5522	0	0	0	0	0	5522	0	0	0	0	0	5522
13H	MARINE 13H	18836	0	0	0	0	0	18836	0	0	0	0	0	18836
13I	MARINE 13I	1491	0	0	0	0	0	1491	0	0	0	0	0	1491
13J	MARINE 13J	2313	0	0	1279	0	0	3592	0	0	0	0	0	3592
13K	MARINE 13K	44	0	0	0	0	0	44	0	0	0	0	0	44
***	SUB-TOTAL	180849	0	24753	4574	0	0	210176	110869	122282	0	0	233151	443327
9A	MARINE 9A	3786	0	0	0	0	0	3786	103	0	0	0	103	3889
12	MARINE 12	139420	0	290	0	0	0	139710	38235	165151	0	0	203386	343096
82A	BIG BEEF C	0	0	0	0	0	0	0	0	0	0	0	0	0
12A	MARINE 12A	2019	0	1	0	0	0	2020	60	40	0	0	100	2120
82F	QUILCENE R	4	0	0	0	0	0	4	0	0	0	0	0	4
12B	MARINE 12B	10553	0	0	5	0	0	10558	501	8425	0	0	8926	19484
82C	OOSEHALLIP	0	0	0	0	0	0	0	0	0	0	0	0	0
82D	DUCKABUSH	0	0	0	0	0	0	0	0	0	0	0	0	0
82E	HAMMA-HAMM	0	0	0	0	0	0	0	0	0	0	0	0	0
12C	MARINE 12C	51922	0	0	0	24	0	51946	6008	18771	0	0	24779	76725
82B	DEWATTO RV	0	0	0	0	0	0	0	0	0	0	0	0	0
82G	SKOKOMISH	9915	0	0	0	0	0	9915	0	0	0	0	0	9915
82J	PURDY C-HC	0	0	0	0	0	0	0	0	0	0	0	0	0
12D	MARINE 12D	0	0	0	0	0	0	0	0	0	0	0	0	0
82H	TAHUYA RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
82I	UNION RVR	0	0	0	0	0	0	0	0	0	0	0	0	0
***	SUB-TOTAL	217619	0	291	5	24	0	217939	44907	192387	0	0	237294	455233
	TOTALS	775371	0	84923	10818	24	170	871306	279029	419184	2019	0	700232	1571538

Table 5. 1988 Washington coastal chum run sizes, catches, and escapements.

	Willapa Bay	Grays Harbor	Quinault R.	Total
Pre-season forecast	99,800	130,000	9,600	339,400
natural	162,000	130,000	min.	
hatchery	37,800	min.	9,600	
Actual run size	225,200	136,300	17,500	379,000
Catch	148,800	72,100	8,600	229,500
Wild esc. goal	35,400	21,000	none	
Wild escapement	61,900	62,200	7,600	131,700
Hatchery esc. goal	N/A	N/A	2,500	
Hatchery escapement	14,500	0	1,300	15,800

Table 6. 1988 chum samples for WDF GSI Baseline

Locality	Number sampled	Collection dates
Canada		
Wahleach	100	28 & 29 November
Indian Arm	100	23November
Westholme Channel/ Chemainus system	100	13 December
Stave	100	10 November
Nanaimo River	100	3 November
Weaver	100	9 November
Moody Channel/ Cheakamus River	100	29 November
Cowichan	100	?
Alouette	100	?
Sooke	100	?
Nitinat	180	?
Washington		
Kendall Creek	50	9 December
	50	16 December
Maple Creek	50	15 December
	50	29 December
Keta Creek Hatchery	55	21 November
	45	23 November
*Fortson Creek	23	7 December
	70	12 December
	18	13 December
*Swift and Perry Creeks	50	17 November
	50	5 December
*Hoodsport Hatchery	50	2 November
	50	17 November
	50	7 December

* - Annual repeat collections

Table 7. Summary of chum salmon GSI samples taken from fisheries in northern Puget Sound

Location	Statistical Week	No. Fish Sampled	Date Sampled	Gear Type	Fishery Type
Strait of Juan de Fuca	40	185	N.A.	GN	test
(Area 5)	41	197	N.A.	GN	test
	42	200	N.A.	GN	commercial
	43	200	N.A.	GN	commercial
	44	200	N.A.	GN	commercial
	45	150	N.A.	GN	commercial
Area 7	41	426	10/4	GN	commercial
	42	401	10/11	PS	test
	42	451	10/16	GN	commercial
	43	363	10/19	GN	commercial
	44	401	10/25	PS	test
Area 7A	41	208	10/3	GN	commercial
	41	245	10/3	PS	commercial
	42	358	10/14	GN	commercial
	42	137	10/14	PS	commercial
	43	251	10/18	GN	commercial
	43	160	10/18	PS	commercial
	44	400	10/27	GN	test
	46	235	11/8	GN	commercial
	46	265	11/8	PS	commercial
	47	56	11/18	GN	commercial
	47	315	11/18	PS	commercial

GN = gillnet PS = purse seine
Source: Nooksack Tribal Fisheries Department

Table 8. Apportionment of 1988 pre-terminal chum salmon commercial net catches for Puget Sound run reconstruction.

Area(s)	Percent United States	Apportionment for Puget Sound Stocks
4B, 5, 6C	30% - Early 60% - Normal 100% - Late	All Puget Sound units by run strength.
6	30% - Early 60% - Normal 100% - Late	All Puget Sound units by run strength.
6A	50% - Early 95% - Normal 100% - Late	80% Sklagit; 10% Nooksack/Samiah; 10% all other Puget Sound units by run strength
7	25% - Early 30% - Normal 20% - Late	All Puget Sound units by run strength.
	5% - Early 5% - Normal 5% - Late	All Puget Sound units by run strength.

Table 9. Total Puget Sound chum run sizes, catches and escapements (1985 - 1988).

Year	Total Run Size	Escapement	Total Catch*
1985	1,454,773	500,660	1,104,967
1986	1,532,692	498,889	1,151,820
1987	1,759,488	474,608	1,327,616
1988	2,039,414	620,416	1,534,617

* - Total commercial catch in all Puget Sound areas; includes some catch from stocks originating outside Puget sound.

ATTACHMENT 3

FINAL 1988 POST SEASON SUMMARY REPORT ON

CHUM SALMON

CANADIAN AGENCY REPORT

REVIEW OF THE 1988 CANADIAN CHUM SALMON FISHERIES

REVIEW OF THE 1988 CANADIAN CHUM SALMON FISHERIES

Introduction

The treaty between the governments of Canada and the United States of America (U.S.) concerning Pacific salmon was designed to facilitate cooperation between the two countries in the management, research and enhancement of Pacific salmon stocks. Chapter 6 of Annex IV of the Pacific Salmon Treaty (PST) required that certain fisheries for chum salmon in southern British Columbia and Washington be managed in a specified manner in 1988. Other fisheries, while not specifically mentioned in the PST, are known to harvest chum of the other country's origin. This report discusses various aspects of the chum present in British Columbian waters between Vancouver Island and the mainland (Inside chum) and off the west coast of Vancouver Island (West Coast chum) and discusses the management actions of Canada in relation to the PST requirements.

Southern B.C. chum salmon stocks and fishing areas are, for the purposes of management, analysis and reporting, divided into two major components. The stocks of Johnstone and Georgia Straits, herein termed Inside chum, and those of the West Coast of Vancouver Island, including Juan de Fuca Strait, termed West Coast chum. The primary fisheries of concern are net and troll fisheries off the west coast of Vancouver Island and net fisheries in Johnstone, Georgia and Juan de Fuca Straits and in the Fraser River.

Inside Chum

I. Conservation and Harvest Management Requirements

Inside chum are managed with the long term objective of providing maximum benefits to the fishing industry. The general approach adopted by the Department of Fisheries and Oceans (DFO) is to achieve the present estimate of optimum wild escapements, while augmenting production through enhancement of selected stocks. In practice, this approach is achieved through the application, in mixed stock fishery areas, of harvest rates which are compatible with wild stock productivity. If there are stocks which return to their area of origin in numbers above that area's escapement goal, they may be subjected to additional harvesting in the appropriate terminal area.

In the years prior to 1983, chum escapements to inside streams averaged less than half the number required to provide maximum production. To increase spawning escapements, DFO, in 1983, initiated a 12 to 15 year conservation plan, known as the clockwork management strategy which was designed to rebuild stocks by reducing harvest rates in the mixed stock areas. The initial portion of the multi-year clockwork plan remained in effect through 1986. In 1987, the stock rebuilding objective was restated and the clockwork plan, with appropriate amendments, entered its second phase. The

second phase was to continue for 1987 and 1988 before re-evaluation. The following describes the clockwork strategy for 1988 and the PST requirements for Inside chum and discusses Inside, Fraser River, and mid Vancouver Island chum stocks in relation to these plans.

i. Clockwork Harvest Strategy

This strategy was more fully described in the Final 1985 Post Season Summary Report of the Joint Chum Technical Committee (Anon.,1987a). The primary objective of the clockwork strategy was to rebuild wild chum stocks to the estimated optimum escapement levels by limiting the overall harvest rate. Specific objectives within this strategy were to:

a. achieve the rebuilding objective within 12 to 15 years;
b. reduce the number of years during which no commercial chum fishing is permitted; and
c. consider wild stock production when establishing harvest management plans.

Under this scheme, harvest rates are directly related to the total run size of the chum run migrating through Johnstone Strait as estimated during the season. The allowable harvest rates for the expected magnitudes of chum salmon run sizes in 1988 were:

a. below 3.0 million, up to a 10% harvest rate;
b. 3.0 to 3.7 million, maximum of 20% harvest rate;
c. 3.7 to 5.2 million, maximum of 30% harvest rate; and
d. over 5.2 million, maximum of 40% harvest rate.

The clockwork strategy was developed to limit the harvest in those areas containing numerous mixed stocks; however, it was recognised that harvesting in terminal areas would be required, particularly in areas of major enhancement. In 1988, it was anticipated terminal harvesting would occur in the mid Vancouver Island (Qualicum, Area 14), Nanaimo (Area 17), Cowichan (Area 18) and Fraser River (Area 29) areas.

ii. Canada/U.S. Treaty

The 1988 changes to the PST were negotiated on the understanding that Canada would manage the 1988 chum fisheries in Johnstone Strait, Strait of Georgia and Fraser River areas in a manner consistent with the clockwork plan and minimize, where practicable, interceptions of United States origin stocks. The U.S. would limit its harvest of Canadian chum in some areas to negotiated catch ceilings as specified in Chapter 6 of Annex IV of the PST.

During the 1988 chum season, the early Johnstone Straits stock size estimates were below the 3.0 million commercial fishing threshold. Consequently, Canada delayed chum

salmon harvesting in Johnstone Strait until mid October when updated run size estimates exceeded 4.1 million chum. The Canadian harvest rate objective increased to 30 percent, the result of the run size increase. As a result, Canada anticipated that the U.S. commercial fisheries in Areas 7 and 7A would reach to 140,000 chum. An assessment of the performance of Canada in the management of the 1988 season is included in Section V of this report.

iii. Fraser River Chum

The chum produced from the Fraser River were of major importance during the development of the clockwork harvest strategy and the negotiation of the PST. While, the Canadian clockwork plan was designed to conserve all inside chum in the Johnstone Straits mixed stock fishery area, this conservation potentially results in terminal Fraser River surpluses. As part of the revisions to the 1988 clockwork, terminal harvesting of Fraser River chum was no longer directly linked to the harvesting pattern in Johnstone Strait. The removal of this linkage required the adoption of a harvesting plan for the Fraser River (Area 29).

The harvest management plan for Fraser River chum conservation was implemented to provide management goals and fishing limits for the harvest of Fraser River chum within the Fraser River. In 1988, the spawning escapement goal for Fraser River chum was set at 700,000. The plan provided for the escapement goal to be increased if the return to the river exceeded the gross escapement goal. Harvest of chum exceeding the gross escapement goal was limited to one half of the surplus.

The catch of Fraser River chum in all fishing areas is estimated to determine the size of the run. In some areas, catch estimates for Fraser River chum are determined through genetic stock identification (GSI) analyses, while in other areas catch estimates are based on traditional perceptions of catch composition.

In 1988, the Johnstone Strait test fishery and both Strait of Georgia and Nitinat commercial fisheries were sampled to estimate stock composition by origin. The catch of Fraser River chum in the U.S. Point Roberts, San Juan Islands and Juan de Fuca fisheries was based on the assumption that 80 to 95 percent of the catch of Canadian chum in those U.S. areas are of Fraser origin. The catch of Canadian chum in those U.S. fisheries was determined through the use of the run apportionment methods (Anon., 1987b).

iv. Strait of Georgia Chum

The chum produced in the mid Vancouver Island area are produced primarily from enhancement facilities. In 1988, a large portion of this return was harvested within Johnstone Strait, under the prevailing 30% clockwork harvest rate. Hence, very minimal harvesting occurred in the mid Vancouver Island area. Terminal harvesting was directed at a mix of surplus mid Vancouver Island wild and enhanced chum, with the conservation

requirements of passing chum stocks considered. In 1988, conservation requirements of local chinook and coho salmon in this fishery area were also considered in the determination of boundaries for the Area 14 chum fishery.

During the 1988 season, chum salmon surpluses to the Nanaimo and Cowichan rivers were identified and terminal harvesting was permitted.

In addition, a terminal harvest occurred at Sooke River on the south west coast of Vancouver Island. This catch is not included in the calculations of total Inside Chum run.

II. Run Size Estimation

Pre-season run size estimates were prepared prior to the season to facilitate the planning of potential conservation actions as well as domestic and international allocations. As the season progressed, revisions to the run size estimates were used to amend harvest plans in accordance with the clockwork approach.

i. Pre-season

The wild run size forecast was determined from the application of past average returns per spawner, adjusted for expected variations, and past average percent return by age group, to the appropriate brood year spawning abundance. The 1988 pre-season forecast of Inside chum originating from wild spawning areas was 2,933,000 including 1,300,000 Fraser River and 1,633,000 non Fraser chum (Table 1).

The number of Inside chum returning to enhanced spawning areas was determined through the application of average survival rates for each type of enhancement facility and the average returns by age group to the number of fry released by the facilities. The 1988 run size estimate for enhanced origin Fraser River chum was 550,000 while the mid Vancouver Island area was expected to produce 464,000 enhanced chum. In addition, there were 42,000 enhanced origin chum estimated to return to other areas, including Howe Sound, lower Vancouver Island, and Jervis Inlet areas. The total run size estimate for enhanced Inside chum was 1,056,000 (Table 1).

The total Inside chum run size was estimated at 3,989,000 (2,933,000 wild and 1,056,000 enhanced). In addition, past data show that U.S. chum migrate through Johnstone Strait. For computational purposes, the estimated run size of U.S. chum forecast to migrate through Johnstone Strait was set at 100,000. This brought the total run size expected to return through Johnstone Strait to 4,089,000 chum.

ii. In-season

The chum catch and vessel effort in a commercial fishery in the third week of September in Johnstone Strait is a reasonably accurate predictor based on past correlations. This is the first in-season run size estimate used in the clockwork plan.

In 1988, the first in-season assessment fishery occurred September 14. However, an Area 29 sockeye seine fishery on the same day resulted in a transfer of gear to that area and a lack of catch and fishing effort in Johnstone Strait. The Johnstone Strait assessment was not considered representative of the run size. As a result, a second assessment fishery was scheduled for September 26; this fishery indicated a Johnstone Strait run size estimate of 2,810,000 chum, 69% of the pre-season forecast (Table 2). The harvest rate allowable under the clockwork plan decreased from a pre-season estimated 30 percent to 10 percent. At that time all, as per clockwork rules, Inside chum stocks were assumed to be returning at this decreased rate of return with the exception of the U.S. run which remained constant (Table 2).

The subsequent in-season run size estimate made on October 6 was based on the chum catch and effort data from the upper Johnstone Strait test fishery and confirmed the run at less than 3.0 million. The following few days of test fishing, however, indicated a minimum run size of 3,100,000 chum entering Johnstone Strait. Based on this run size, the harvest rate increased from 10% to 20%, and a commercial fishery was scheduled for October 13.

Commercial fishing during this 3rd week in October resulted in the highest weekly catch since 1973 and a one day historic high catch. Total stock abundance estimates from this fishery combined with previous stock size estimates projected a run size of 4,153,000. This increase in stock size raised the clockwork harvest rate from 20% to 30% and left a balance of approximately 225,000 to harvest in Johnstone Strait.

Based on this run size, a final commercial fishery was scheduled for October 20. This catch assessment combined with the remainder of the seasonal test fishing resulted in a final in-season run assessment of 4,217,000 chum for 1988.

Initial estimates of Fraser River total run size are made in Johnstone Strait from commercial and test fishing assessments combined with GSI data. The Fraser River test fishing was used after mid October to determine the estimated return to the terminal area. The final in-season estimate of total Fraser River run size available from Johnstone Strait test fishing was 1,909,000 chum. Test fishing within the Fraser River was conducted from October 1 to December 13. The final in-season estimate of the terminal run size to the Fraser River was 560,000 chum (Table 2).

iii. Post-season

At the end of the season, the total catch in all Inside areas, catch of Canadian chum in U.S. areas 7 and 7A and Inside chum gross escapements were summed to estimate the total Clockwork assessed run size (Table 9). This estimate is limited to catch and escapements of stocks which are assessed in their migration through Johnstone Strait and does not included Study Area catches from the West Coast. In addition, the total run size of Fraser River chum was calculated by applying stock composition data derived from GSI samples in selected areas.

The post-season clockwork run size estimate for chum was 3,138,000 chum (1,669,000 gross escapement and 1,469,000 total catch). This figure approximates the total stock which migrates through Johnstone Strait and comprises the Clockwork assessed stock size. The post-season estimate was 74% of the final in-season estimate of 4,217,000 chum salmon and 79% of the pre-season forecast of 3,989,000 chum.

The Fraser River post-season run size estimate, including the catch of Fraser River chum in U.S. and Canadian waters, was 1,153,000 (459,000 gross escapement and 694,000 total of catch in Canadian and U.S. waters). This run size was 62% of the pre-season forecast.

Based on the assumption that the percentage of Fraser River chum caught in the U.S. Point Roberts, San Juan Islands and Juan de Fuca fisheries is 90%, 56%, 32% respectively, the total catch of Fraser River Chum in these fisheries was 127,000. This includes 96,306 in areas 7 and 7a and 30,719 in areas 4B, 5, and 6C. The catch of Fraser River chum in the Johnstone Strait, Strait of Georgia, and Nitinat commercial net fisheries were estimated, through analysis of GSI data, to be 254,900 chum, 4,600 chum, and 206,200 chum, respectively. The use of current GSI analysis to determine Fraser River interceptions in the Nitinat catch is under review.

III. Catch

Chum in Inside waters are harvested by commercial, Indian food, and test fishermen and by biological samplers. In 1988, these harvests totalled 1,361,000. The catch by each fishing group and area is presented below.

i. Commercial

Commercial catch of chum in Inside waters occurs in three main areas: Johnstone Strait, Strait of Georgia and the Fraser River.

The 1988 Johnstone Strait fishery (areas 11, 12 and 13), began in July and ended in late September. During the July and August period, the Johnstone Strait fishery was directed at harvesting sockeye and pink salmon. During those two months, 50,000 chum

salmon were harvested (Table 3). These chum are assumed to be comprised mainly of summer chum destined for streams in the Johnstone Strait and Canadian central coast areas and are not part of the clockwork management plan.

As part of the clockwork plan, a commercial assessment fishery during the third week of September is required to provide a run size estimate. In 1988, because of the need to harvest Fraser sockeye late in the season, an Area 29 seine fishery occurred during the same week as the Johnstone Strait chum assessment fishery. The Johnstone Strait fishery harvested 33,000 chum, however, it was not considered a valid assessment of the run size because of a lack of fishing effort. Therefore, a second assessment fishery occurred during the first week of October. The catch of 179,000 was used to develop the first in-season run size estimate of 2,810,000 chum. At this run size, further commercial harvesting is restricted by the clockwork strategy and the total harvest rate was limited to 10%

A subsequent in-season run size update on October 11, based on test fishing, indicated a minimum run size of 3,100,000. Under the clockwork strategy, a harvest rate of 20% was allowed and a fishery scheduled for October 13. The catch for the fishery totalled 442,500 chum. Assessment of the in-season estimated catch from this fishery indicated a Johnstone Strait run size of 4,153,000 for which a 30% harvest rated was allowed. Due to this increased allowable harvest rate and an outstanding balance to catch, a fishery occurred on October 20. Catch for this final fishery totalled 367,000.

Fishing in the Strait of Georgia was limited to three areas, mid Vancouver Island (Area 14), Nanaimo (Area 17) and Cowichan (Area 18) in 1988. These commercial fisheries were directed at both wild and enhanced chum. In Area 14, the first opening occurred on October 13 and coincided with the Johnstone Strait opening. The final commercial fishery occurred two weeks later on October 24. Catch for these fisheries was 20,000 and 18,000 respectively (Table 3). There was no late cleanup fishery in Area 14, the result of the large catch of mid Vancouver Island stocks in the earlier Johnstone Strait fisheries.

In Area 17, a one day fishery, targeting on Nanaimo River stocks, harvested approximately 23,100 chum. In Area 18, three fisheries occurred on November 9, 15 and 22 harvesting Cowichan River chums. Catches for all three fisheries totalled 56,000.

A terminal daylight fishery occurred in Area 20 adjacent to the Sooke River on October 26, harvesting 11,000 surplus chum. This chum catch is not included in the Inside chum catch as this system is not enumerated in the Inside chum escapement summary.

A Fraser River Panel opening was held October 4 for sockeye and pink salmon. A total of 32,300 chum salmon were caught. The first estimate of the Fraser River terminal run size was developed mid October and indicated a run size of 990,000 (Table 2). Under the Fraser River Chum Harvest Management Plan, one commercial fishery was permitted on October 20 which caught 42,700 chum salmon. Subsequent test fishing evaluations decreased the estimated terminal run size to 560,000 chum by December 13.

No fishing opportunities were identified after October 20. The balance of the catches reported in Table 3 were taken by test fishing vessels.

ii. Test and Sample

The abundance of chum was monitored through test fishing programs in Johnstone Strait and the Fraser River. In addition, sampling for GSI purposes was conducted in Johnstone Strait and the Strait of Georgia.

The abundance of chum in Johnstone Strait was assessed, in part, through test fishing by two seine vessels in Area 12. The test fishing in Area 12 began in early September and continued until mid November (Table 4). During that time the two vessels enumerated a total of 106,000 chum, the majority of which were released. Included in the commercial catch reporting are 14,300 chum retained as payment for the operation of test fishing vessels. In addition 2,500 chums were sampled for biological purposes (Table 8).

The Area 12 test fishing data were utilized to determine relative weekly chum abundance and the magnitude of the total run entering Johnstone Strait. The weekly data indicated a peak of abundance in the third week of October (Table 4). The relationship between catch per unit effort in the test fishery and the total run size was monitored weekly throughout October to assist in the determination of the in-season estimates of the run size (Table 2).

Within the Strait of Georgia, 800 chum from the commercial fisheries in areas 14 and 17 were sampled for GSI information (Table 8).

Two test fisheries were conducted within the Fraser River. Fishing occurred daily at the Cottonwood site in the lower river near Ladner, and in the upper commercial fishery area near Albion.

The chum test fishery at Cottonwood was used to determine the size of Fraser River chum run and to monitor daily abundance. This daily test fishery began October 1 and continued until December 13. During this period a total of 3,100 chum were caught (Table 5).

The test fishery at Albion, which provides a second indication of abundance and the rate of upstream movement, began on October 1 and continued until December 13. During this period 4,600 chum were caught (Table 5).

iii. Indian

Native people within British Columbia are permitted to harvest chum for their food fish needs. Indian food fish catches occur in Johnstone and Georgia straits and

within streams flowing into these areas. The largest single stream system from which Indians harvest food fish is the Fraser River.

In 1988, the Indian food fishery in the Inside waters harvested 77,000 chum, of which the food fishery in Johnstone Strait harvested a total of 25,000 chum, the majority of which were taken in marine waters in October. In the Strait of Georgia there were 33,000 chum taken in the Indian food fishery. The majority of the Indian food fish caught in the Strait of Georgia are taken in stream estuaries or within the streams, often as surplus chum from enhancement facilities. The food fishery within the Fraser River took a estimated total of 19,000 chum. In addition 2,000 chum went to Indian food fish in Area 20 from the Sooke River stock. This catch is not included in the Inside chum catch.

IV. Escapement

Chum which elude the commercial, test, sampling, and Indian fisheries form the gross escapement to Inside chum streams. This gross escapement is made up of chum which spawn in wild areas, those which are spawned in enhancement facilities, and those which are surplus to facility requirements and are removed from the spawning areas. Gross escapement estimates are used in reconstruction of the total run size in a given year.

i. Spawning

Some of the streams within the Inside area contain summer run spawners. These are relatively minor stocks and because of their distinctively early run timing in Johnstone Strait, i.e. July to late August, are not included in the escapement total for the fall chum run. The total escapement of summer chum in 1988 was 29,000 chum.

The stocks which are managed within the context of the clockwork plan and of concern to the PST are the fall run chum. These chum enter Johnstone Strait during the September to November time period. The estimated number of all Study Area fall chum spawning in wild spawning areas was 1,480,000 chum. This escapement was 93% of the 1983 to 1987 average escapement.

With regard to specific areas, a below average escapement was reported for the Fraser River. Spawning ground enumeration effort in 1988 was significantly reduced from previous years and therefore observed number of spawners was not usable. The estimate of 400,000 chum in the wild spawning areas of the Fraser River was based on analysis of test fishery data and limited observations of spawning populations.

In five of the fourteen major spawning areas, the 1988 chum escapement was below the average observed during the 1983-87 period (Table 6). Overall, the fall chum spawning escapement in wild spawning areas for 1988 was 74% of the present interim total spawning goal of 2,000,000 chum. There was only one of the fourteen stock areas (Loughborough to Bute Inlets) which received an escapement at or above the goal.

Figure 1 shows total Inside chum stock size and wild escapement for the years prior to Clockwork management (1980-1982) and under Clockwork management (1983-1988). Data is provided in Table 7.

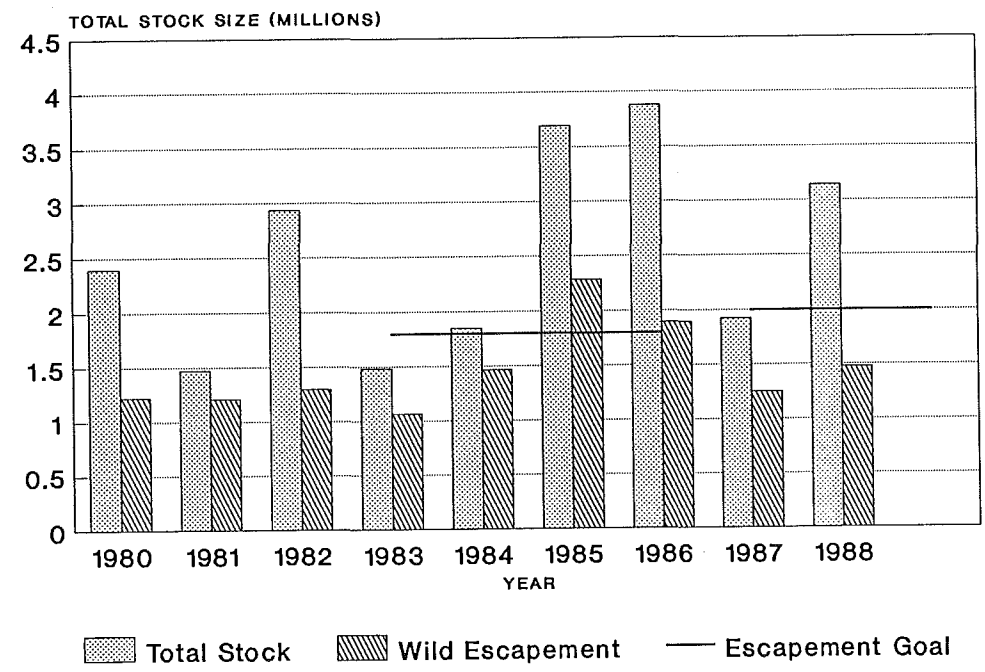


Figure 1: Inside chum wild escapement and total stock size, 1980 - 1988

ii. Enhanced

The primary enhanced escapement areas are presently limited to the mid Vancouver Island and Fraser River areas. The enhancement facilities in the mid Vancouver Island area received 87% of their spawning requirements (Table 6). Broodstock requirements for all major Fraser River facilities with the exception of Chilliwack Hatchery were met. Wherever possible, enhanced chum not required for broodstock are diverted to wild spawning areas to spawn.

iii. Gross Escapement

The gross escapement in 1988 was estimated at 1,669,000 fall chum of which 1,480,000 spawned in wild or natural spawning areas. The remaining 190,000 were spawned in enhancement areas, facilities or were surplus to hatchery requirements (Table 6).

V. Status of Treaty Requirements

i. Overall Fishery Management

The in-season management decisions by DFO in 1988 reflected run size estimates and their revisions based on assessments of in-season data from test and commercial fishing. The commercial assessment fishery in the fourth week of September indicated a run size of 2,810,000 chum which was lower than the pre-season forecast and limited the harvest rate to 10% of the total run. However, subsequent test fishing and commercial catch assessment estimates increased this initial run size and resulted in a seasonally estimated run size through Johnstone Strait of 4,217,000 chum. Management actions were designed in Johnstone Strait to give effect to a 30% harvest of this total stock or a catch in all clockwork areas of 1,265,000. In-season, calculations of the clockwork harvest rate indicated the catch was marginally greater than the clockwork goal at 31.9%. The post-season review indicated, however, that in-season assessments of run size overestimated the total returning stock size and resulted in an over-harvest of the returning Inside chum run.

The total Clockwork assessed run size includes the gross escapement of Inside chum, the total catch in Inside areas, and the apportionment of the commercial catch in U.S. areas 7 and 7A which was of Canadian origin. The 1988 gross escapement was 1,669,000; the Inside chum commercial catch 1,284,000; the IFF catch 77,000 and the United States estimated catch of Canadian origin chum 109,000. This run size was estimated to be 3,138,000 chum. The total clockwork catch, as calculated, including the appropriate Canadian and U.S. fisheries, was 1,217,000 with an overall clockwork harvest rate of 38.8 percent (Table 9).

An assessment of Clockwork management is provided for the years 1983 to 1988 in Table 10.

ii. Stock Identification

Genetic stock identification (GSI) was conducted in a number of areas in 1988. The majority of the GSI work concentrated on sampling of commercial fishery areas or commercial catches.

The commercial fishery areas sampled in 1988 were upper Johnstone Strait (Area 12), mid Vancouver Island (Area 14) and Nanaimo (Area 17). The samples in areas 14 and 17 were from the commercial catch. In Area 12 the samples were from chum caught by test fishing vessels (Table 8).

Table 1. Preseason run forecasts by stock, 1988.

Stock	Origin	Expected run size		Percent run size	
Canadian Inside Chum					
Fraser River:	Wild	1,300,000		31.8%	
	Enhanced	550,000		13.5%	
	sub-total		1,850,000		45.2%
Mid Vancouver Island:	Wild	a.			
	Enhanced	464,000		11.3%	
	sub-total		464,000		11.3%
Non-Fraser Stocks:	Wild	1,633,000		39.9%	
	Enhanced	42,000		1.0%	
	sub-total		1,675,000		41.0%
Total Inside Stocks:	Wild	2,933,000		71.7%	
	Enhanced	1,056,000		25.8%	
	Total		3,989,000		97.6%
U.S. Chum					
Puget Sound:		100,000		2.4%	2.4%
		GRAND TOTAL	4,089,000	100.0%	100.0%

a. Included in Total Inside Stocks, wild total

Table 2. Summary of pre-season, in-season and post-season chum run size estimates, 1988

Week Ending	Total through J.St.	U.S.	Canadian Total	Fraser River	Mid Vancouver Island	Other Inside Canadian
PRESEASON	4,089,000	100,000	3,989,000	1,850,000	464,000	1,675,000
INSEASON (a) (Johnstone Strait fishery)						
01-Oct	2,810,000	100,000	2,710,000	1,256,800	315,200	1,137,900
08-Oct	2,810,000	100,000	2,710,000	1,256,800	315,200	1,137,900
11-Oct	3,100,000	100,000	3,000,000	1,391,300	349,000	1,259,700
15-Oct	4,153,000	100,000	4,053,000	1,879,700	471,400	1,701,900
22-Oct	4,272,000	100,000	4,172,000	1,934,900	485,300	1,751,800
29-Oct	4,217,000	100,000	4,117,000	1,909,400	478,900	1,728,700
(Estimates from Fraser River test fishing - terminal run size)						
Oct 16	-	-	-	910,000	-	-
Oct 31	-	-	-	740,000	-	-
Nov 14	-	-	-	650,000	-	-
Nov 28	-	-	-	560,000	-	-
Dec 13	-	-	-	560,000	-	-
POSTSEASON	-	-	3,138,000	1,153,000 (b)	-	-

a. In-seastotal run size estimates based on following:
USA assumed constant at 100,000
Fraser River and MVI same proportion as pre-season.
non-Fraser is remaining difference.

b. Fraser River post-season includes chum caught in US areas 4b,5,6,7,7A and in Canadian areas 12,13,14,17,20,21,29.

Table 3. Catch of chum salmon by statistical area for commercial and test fishing vessels and by Indian food fisheries, 1988.

Week ending	Statistical Areas 11	12	13	14	15-19	20	29	Total
03-Sep	174	1	60	1	0	18	5	259
10-Sep	180	20	0	0	0	0	13	213
17-Sep	369	28,365	4,769	5	2	0	1,257	34,767
24-Sep	0	0	162	0	0	0	3,598	3,760
01-Oct	0	99,360	79,761	1	51	0	523	179,696
08-Oct	0	0	51	0	0	0	32,345	32,396
15-Oct	0	212,066	230,418	19,886	0	0	2,126	464,496
22-Oct	0	106,397	260,482	371	0	0	42,653	409,903
29-Oct	0	32,331	24,569	18,407	23,110	(11,054)a	1,127	99,544
Nov.1 to Nov.28	0	0	0	0	48,749	0	2,121	50,870
Nov 29 to Dec.31	0	0	0	0	7,626	0	302	7,928
TOTAL	723	478,540	600,272	38,671	79,538	18	86,070	1,283,832
Prior to 29-Aug	18,449	29,613	1,595	2	9	1,558	34	51,260
Indian Food Fishery	0	7,190	17,518	2,940	30,060	(2100) b	19,143	76,851
Grand total	19,172	515,343	619,385	41,613	109,607	1,576	105,247	1,411,943

Source: British Columbia Catch Statistics, 1988.

Note: a. Catch in Sooke Basin fishery in Area 20 (week ending Oct. 29) of 11054 not included in table of Inside chum catch.
b. IFF catch in Area 20 from Sooke River and is not included in Inside chum catch

Table 4. Catch, effort, and catch per unit effort in Johnstone Strait test fisheries, 1988.

Week Ending	Stat Week	Weekly Catch	Effort (sets)		Catch per set
Upper Johnstone St.					
10-Sep	9/2	240	18		13.3
17-Sep	9/3	713	20		35.7
24-Sep	9/4	2,456	40		61.4
01-Oct	10/1	2,502	23		108.8
08-Oct	10/2	18,026	42		429.2
15-Oct	10/3	36,385	22		1653.9
22-Oct	10/4	5,090	21		242.4
29-Oct	10/5	7,549	33		228.8
05-Nov	11/1	1,343	23		58.4
	sub total	74,304	242	avg.	314.6
Mid Johnstone St.					
10-Sep	9/2	193	18		10.7
17-Sep	9/3	477	24		19.9
24-Sep	9/4	3,526	39		90.4
01-Oct	10/1	2,240	18		124.4
08-Oct	10/2	6,718	41		163.9
15-Oct	10/3	6,377	18		354.3
22-Oct	10/4	4,114	20		205.7
29-Oct	10/5	7,394	30		246.5
05-Nov	11/1	455	14		32.5
	sub total	31,494	222	avg.	138.7
	Grand Total	105,798	464	avg.	228.0

Table 5. Weekly total catch and catch per unit effort in Fraser River chum test fisheries in 1988.

Week Ending	Cottonwood		Albion	
	Catch	CPUE	Catch	CPUE
01-Oct	12	1.7	58	4.6
08-Oct	599	53.9	622	46.6
15-Oct	562	57.3	525	37.7
22-Oct	525	51.7	640	47.1
29-Oct	539	44.1	587	49.3
05-Nov	236	21.3	503	38.1
12-Nov	239	26.5	435	38.1
19-Nov	179	19.1	365	29.5
26-Nov	158	19.1	207	18.8
03-Dec	70	8.8	210	18.3
10-Dec	23	2.8	88	8.8
17-Dec	6	0.5	25	2.8
Total	3148	306.8	4265	339.7

Note: rounding errors may be present.

Table 6. Number of inside chum spawning in wild areas, and number spawning in enhanced facilities or otherwise utilized by hatcheries, in 1988, compared to spawning capacity and to previous five year averages.

Spawning Areas by Stock Group	Target Escapement	1988 Estimate	1988 as percent of Target	1983 - 87 Average	1988 as percent of 83-87 Ave
Wild Spawning Areas					
Upper Vancouver Island	33,000	300	1%	600	50%
Kingcome Inlet	114,000	16,700	15%	5,500	304%
Bond to Knight Inlet	220,000	46,200	21%	37,200	124%
Johnstone Strait	137,000	103,600	76%	49,700	208%
Loughborough/Bute Inlet	150,000	184,200	123%	149,100	124%
Mid Vancouver Island	149,000	97,000	65%	143,800	67%
Toba Inlet	136,000	75,000	55%	13,000	577%
Jervis Inlet	150,000	123,900	83%	122,900	101%
Lower Vancouver Island	147,000	60,500	41%	71,300	85%
Southern Vancouver Island	238,000	236,500	99%	181,400	130%
Howe Sound/Sunshine Coast	350,000	93,700	27%	181,500	52%
Burrard Inlet	50,000	41,000	82%	30,500	134%
Fraser River	700,000	400,000	57%	604,300	66%
Boundary Bay	5,000	1,000	20%	400	250%
WILD TOTAL	2,579,000 a	1,479,600	57%	1,591,200	93%
Enhanced Spawning Areas					
Mid Vancouver Island	150,000	130,900	87%	159,300	82%
Fraser	30,000	58,700	196%	21,900	268%
ENHANCED TOTAL	180,000	189,600	105%	181,200	105%
GRAND TOTAL	2,759,000	1,669,200	61%	1,772,400	94%

a. Long term goal. Interim goal for 1987-1990 is 2,000,000.

Table 7. Total stock, catch, escapement, wild escapement and Clockwork and actual harvest rate for Inside chum, 1980 - 1988.

YEAR	TOTAL STOCK	TOTAL CATCH	TOTAL ESC	WILD ESC	CLOCKW HR	ACTUAL HR
1980	2,396,200	1,085,200	1,311,000	1,217,800	NA	NA
1981	1,469,300	177,200	1,292,100	1,210,100	NA	NA
1982	2,938,000	1,523,000	1,415,000	1,299,000	NA	NA
1983	1,481,400	288,100	1,193,300	1,063,300	10.0%	11.6
1984	1,844,500	280,100	1,564,400	1,464,200	10.0%	6.8
1985	3,691,500	1,232,500	2,459,000	2,285,700	30.0%	23.9
1986	3,875,900	1,813,600	2,062,400	1,890,800	30.0%	37.8
1987	1,923,000	544,700	1,378,400	1,251,700	10.0%	11.8
1988	3,138,400	1,469,200	1,669,200	1,479,600	20.0%	38.8

Wild escapement goal for 1983-86 was 1.8 million.
Wild escapement goal for 1987-90 was 2.0 million.

Table 8. Number of chum salmon sampled for GSI data, 1988.

Area	Weeks Sampled	Commercial Samples	Test fish Samples
Johnstone Strait	9	0	2,518
Qualicum	2	675	0
Nanaimo	1	142	0
Nitinat	7	2,193	348
Total		3,010	2,866

Table 9. Summary of Clockwork catch, escapement and harvest rate, 1988.

Fishery Type	Areas	Total Catch	Contribution to Clockwork	Clockwork Catch
Commercial and Test	12 & 13	1,079,535	100%	1,079,535
	14	38,671	10% a	3,867
	29	86,104	0%	0
	other	79,538	0%	0
	sub total	1,283,848		1,083,402
Indian Food	12 & 13	24,708	100%	24,708
	29	19,143	0%	0
	other	33,000	0%	0
	sub total	76,851		24,708
U.S.	7	64,933	70% b	45,453
	7A	66,413	95% b	63,092
	sub total	131,346		108,545
		Total Clockwork catch		1,217,000
		Total Escapement		1,669,000
		Total Clockwork Assessed Stock		3,138,000 c
		Clockwork Harvest Rate		38.8%
		Total Study Area Stock Size		3,493,000 d

a. Based on GSI data.
b. Based on apportionment methods as per Chum Technical Report 88-4
c. Total Clockwork Assessed Stock Size (Commercial, IFF and Test catch Area 11-20 plus the Canadian component of the US catch Areas 7 & 7a
d. Total Study Area Run Size (Commercial, IFF and Test catch Area 11-20 & 29 plus Canadian component of the US catch Areas 4b,5,6c,7, & 7a plus Can. Area 21(Nitnat) catch of Study Area origin minus Can. catch of US origin chum in the Study Area)

Table 10. Assessment of Clockwork management, 1983 - 1988.

	1983	1984	1985	1986	1987	1988
1. INSEASON...						
Assessed Total Stock	1,420,000	1,810,000	2,970,000	3,806,000	2,305,600	4,217,000
Desired HR	10.0%	10.0%	20.0%	30.0%	10.0%	30.0%
Apparent HR	12.1%	6.9%	29.6%	38.5%	9.8%	28.9%
2. POST SEASON...						
Actual Total Stock	1,481,400	1,844,500	3,691,500	3,875,900	1,923,000	3,138,400
COMM & TF A11-13	101,839	38,251	516,314	1,131,377	68,414	1,079,535
COMM & TF A29	12,557	15,093	52,543	98,922	10,035	N.A.
COMM A 14 FR	N.A.	N.A.	77,675	76,130	25,505	3,953
IFF A11-19,29	49,600	64,300	76,100	59,200	83,700	24,708
US 7-7A	8,100	7,400	157,900	98,400	38,800	108,500
Total	172,096	125,044	880,532	1,464,029	226,454	1,216,696
Desired HR	10.0%	10.0%	30.0%	30.0%	10.0%	20.0%
Actual HR	11.6%	6.8%	23.9%	37.8%	11.8%	38.8%
3. ESCAPEMENT...						
Goal	1,800,000	1,800,000	1,800,000	1,800,000	2,000,000	2,000,000
Estimated wild	1,063,000	1,464,000	2,286,000	1,891,000	1,252,000	1,480,000
Difference	-737000	-336000	486,000	91,000	-748000	-520000

Note:
1. Clockwork catch 1983-87 included commercial catches from Areas 11-13 (After Sept. 1) Area 14 Fraser origin catch and Area 29, IFF catches Areas 11-13 and 29, Test catches from Area 11-13 and 29, and U.S. catches of Can. chum in Areas 7 and 7A
2. Clockwork catches for 1988 excluded catch from the Area 29 fishery. Fraser River catches were accounted for in the Fraser River clockwork.
3. Clockwork total Stock is Commercial, IFF and Test Catches for Areas 11-20 and 29 plus the Canadian component fo US Areas 7 and 7a

West Coast Chum

I. Conservation and Harvest Management Requirements

West Coast chum return to a number of inlets on the west coast of Vancouver Island. For the purposes of the PST the main stock of concern originates from the Nitinat system, while the commercial fisheries of concern are net harvests adjacent to Nitinat (Areas 21 and 22).

The chum returning to Nitinat are managed so that the wild spawning areas receive their escapement goal of 200,000 chum, of which 150,000 are required in the Nitinat River, and so that the hatchery obtains its required egg supply. Surpluses are harvested in commercial fishing areas in Area 21, adjacent to the entrance to Nitinat Lake. This commercial fishing area is used instead of fishing in the lake to increase the safety of fishing conditions for the fleet and to improve the quality of the catch. In addition, the commercial fishery for Nitinat chum is managed to allocate the catch between gillnet and seine gear types.

An additional ongoing management objective is to quantify the incidence of chum originating from other areas in the Nitinat commercial fishery. This quantification is required under PST provisions and for domestic stock management purposes.

II. Run Size Estimation

The only harvestable surplus expected in 1988 was that originating from the hatchery. The wild run size was not predicted.

The enhanced run size expected was 516,000 of which 341,000 were to be available for harvest. The remainder were to be used to fill the egg take requirements of the hatchery (anticipated to require 16,500 adults) and to meet escapement requirements of the area.

There are no in-season revisions to estimates of run size made in the Nitinat area. Catch and escapement are monitored and commercial harvesting is adjusted as required.

The post-season estimate of the run size returning to Nitinat in 1988 was determined by adding escapement to the catch of west coast chum in the Area 21 fishery as determined by genetic stock identification. These are preliminary estimates. Further work is required to determine the accuracy of these estimates. The estimated size of the run was 1,636,103 (256,800 gross escapement and 1,379,303 catch).

III. Catch

i. Commercial

The commercial chum salmon fishery in Area 21 was held over a period of seven weeks from September 26 through November 14, 1988. The area was closed during the sixth week (October 30-Nov 5). The total catch for commercial and test fisheries was 1,795,000 chum (Table 1). Incidental catch of other species during the full fishing period was 1,035 chinook and 8,550 coho.

The first opening was used to determine the relative abundance of chum in the fishing area. To limit the catch, the area was opened for gillnets only; 69,000 chum were caught.

The opening in the following week was also restricted to gillnets until they achieved their early season allocation of 125,000 chums. In the first two days, gillnets caught approximately 58,000 chums for a total of 127,000 chums. The high level of catch and strong escapements observed by October 2 indicated that the run was much stronger than expected. As full escapement requirements were received in the lake much earlier than expected, the scheduled seine fishery was advanced from October 12 to October 5. At this point, seines fished for their early season allocation of 125,000 chums. In one days fishing, seines caught approximately 225,000 chums. With this apparent abundance seines continued fishing, and gillnets began the following day (Oct 7), and gillnets and seines fished on the same days for the rest of the season. During the second week, gillnets caught 60,000 chums and seines caught 618,000 chums for a total of 678,000 chums.

The third week harvested 574,000 chum (combined gillnet and seine). The fourth week harvested 247,000 chums, the fifth week harvested 194,000 chums, the sixth week was closed (but 2,200 chums were taken by the test boat), the seventh week harvested 31,000 and 150 chums were taken in the eighth week by the test boat.

The fishing boundaries were made larger in 1988 to deal with the exceptionally large run. Additional area to two miles offshore between Carmanah and Pachena Points were made available to both gillnets and seines to avoid congestion and to efficiently harvest the surplus.

In the waters off the west coast of Vancouver Island (areas 21-27) the commercial troll fishing fleet harvested 80,000 chum salmon. The majority of the catch occurred in July and August and were thought to be returning to streams in the north and central coast areas of British Columbia.

ii. Test and Sample

There were 37 boat-days of test fishing to monitor chum abundance in Area 21 in the period between the first and last openings. This test fishing harvested an estimated 22,600 chum salmon.

In addition, a total of 2193 samples for genetic stock identification were taken from the commercial catch in the seven fishing weeks. A further 348 samples were taken in the weeks of October 5 and November 5 from the test fishery. The above catches are included in the total commercial catch for the area. Another 180 samples were taken from the hatchery. These hatchery fish are included with the numbers taken for broodstock.

iii. Indian

There were 1,500 chum reported in the Indian food fishery in the Nitinat area.

IV. Escapement

The escapement to the wild spawning grounds of the Nitinat system was 241,800. The gross escapement to the Nitinat system was 256,800 chum in 1988. This was the highest escapement in the years 1985 to 1988 (Table 2).

Two to three thousand chum swam into the hatchery. Also, 11,246 chum were taken by seine net in Nitinat Lake and River and used for brood stock. The Nitinat hatchery eggtake was 3 million below the 23 million goal due to pre-spawning mortality caused by a turn over of Nitinat Lake.

V. Status of Treaty Requirements

Canada was to manage the Nitinat net chum fishery to minimize the harvest of non-targeted stocks. Samples of the commercial fishery in the Nitinat area were taken to determine stock composition (Table 8).

Table 1. Summary of Nitinat (Area 21) Catch, Escapement and Run Size, 1988 (Data from catch database on PBS VAX)

Statistical Week	Week Ending	Catch
8/4	Aug 27	0
9/1	Sep 03	0
9/2	Sep 10	0
9/3	Sep 17	0
9/4	Sep 24	0
10/1	Oct 01	69,416
10/2	Oct 08	678,205
10/3	Oct 15	573,898
10/4	Oct 22	247,017
10/5	Oct 29	193,595
11/1	Nov 05	2,182
11/2	Nov 12	30,889
11/3	Nov 19	152
11/4	Nov 26	0
12/1	Dec 03	0
Total Catch		1,795,354
Total Catch Nitinat Stock		1,379,303
Total Nitinat Escapement		256,800
Nitinat Run Size		1,636,103

Table 2. Summary of Nitinat (Area 21) Catch and Escapement, 1985 - 1988.

Year	Total Catch	Total Escapement[1]
1985	1,609,364	210,000
1986	387,470	142,820
1987	395,397	50,200
1988	1,795,354	256,800

1. Includes both wild fish and those used for enhancement purposes as well as pre-spawning mortalities caused by a lake turnover.

ATTACHMENT 4

LOCATION MAPS

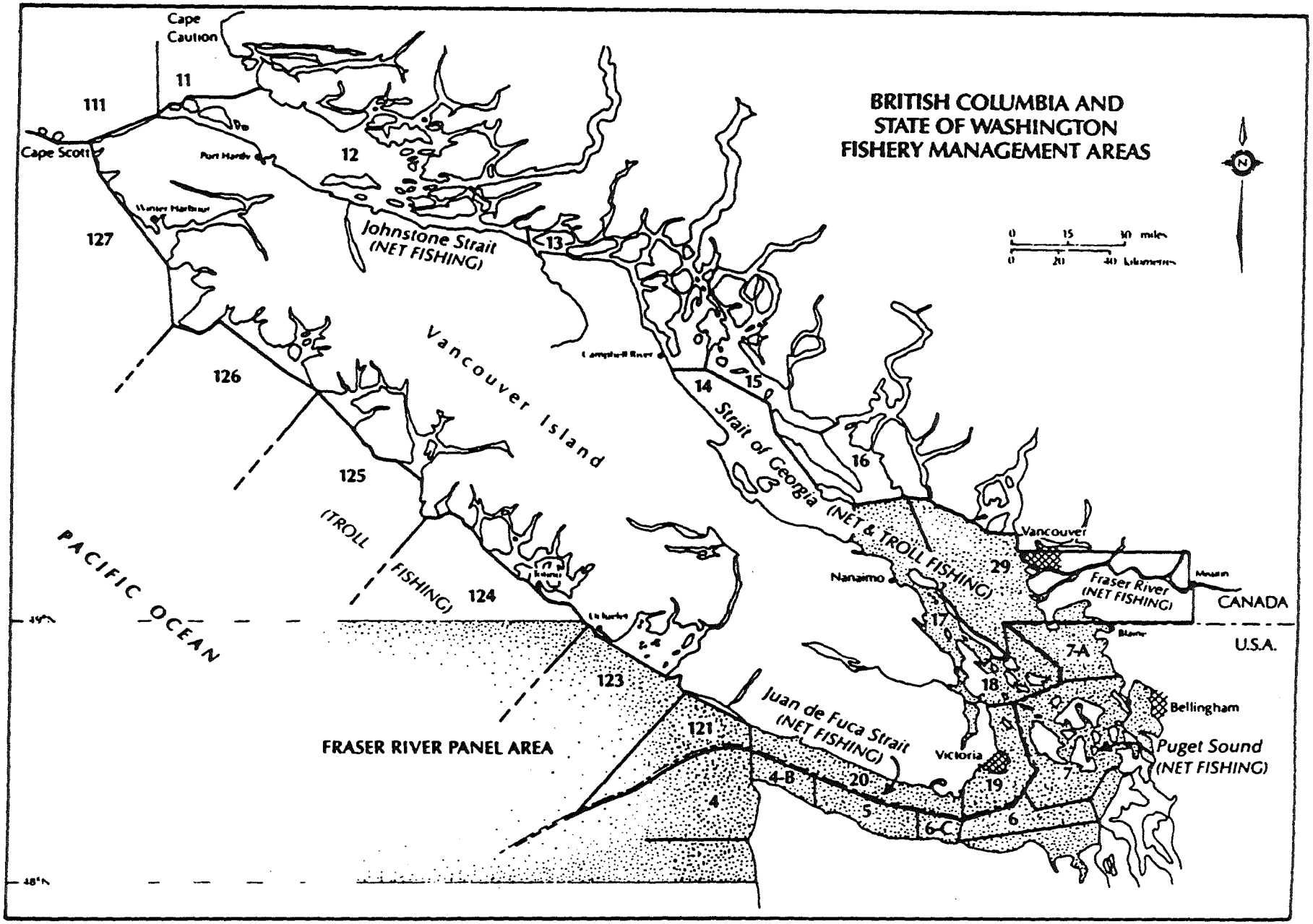
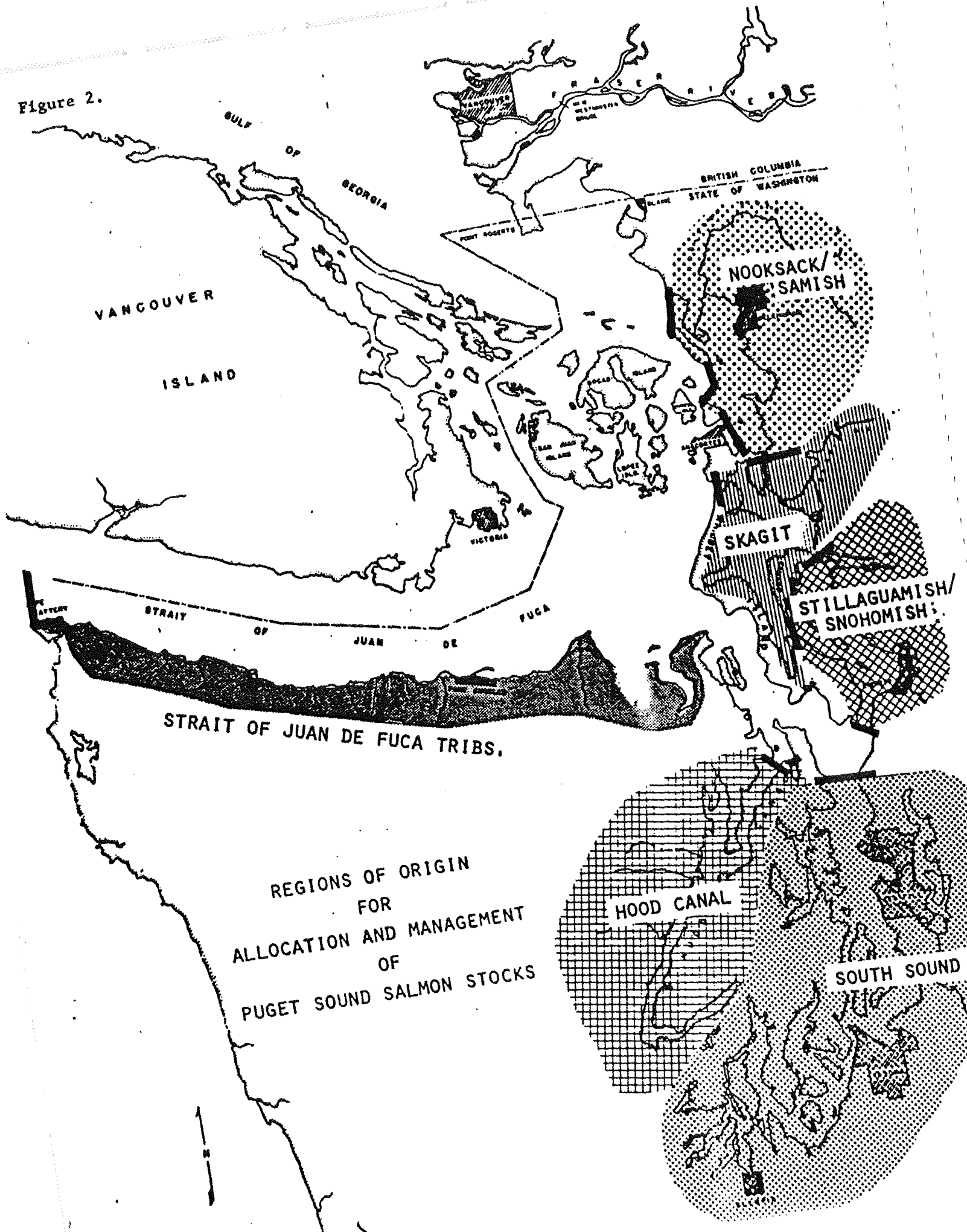


FIGURE 1. Fishery management areas in the Fraser River Panel Area, along Canada's south coast and in United States waters. The type of fishery (net or troll) that operates in each area is also indicated.

Figure 2.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VANCOUVER ISLAND
FRASER RIVER
VANCOUVER
BRITISH COLUMBIA
STATE OF WASHINGTON
POINT ROBERTS
NOOKSACK/ SAMISH
SKAGIT
STILLAGUAMISH/ SNOHOMISH
VICTORIA
STRAIT OF JUAN DE FUCA
STRAIT OF JUAN DE FUCA TRIBS.
HOOD CANAL
SOUTH SOUND
REGIONS OF ORIGIN
FOR
ALLOCATION AND MANAGEMENT
OF
PUGET SOUND SALMON STOCKS
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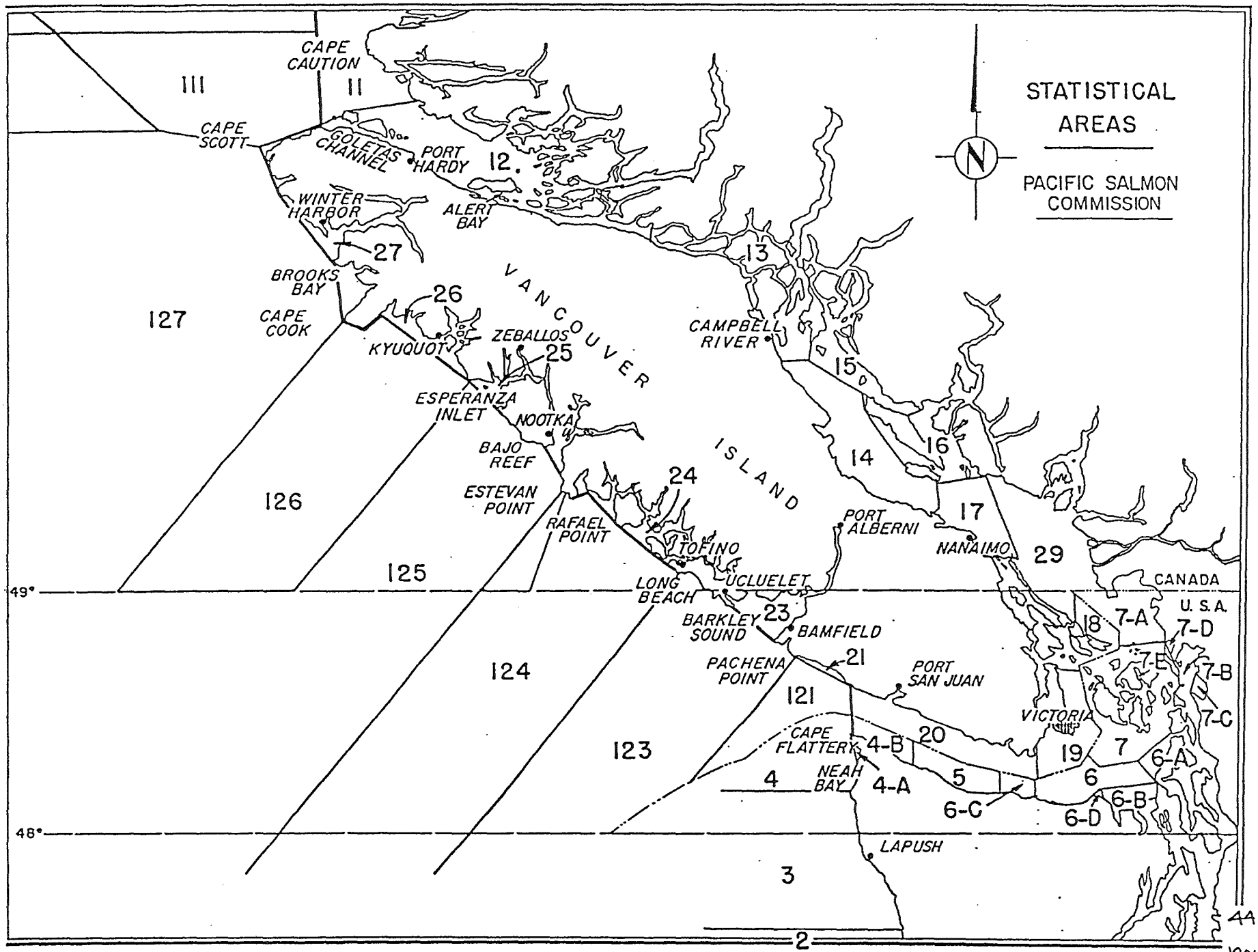
WDF 1/87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GOLETAS CHANNEL
PORT HARDY
WINTER HARBOR
ALERT BAY
BROOKS BAY
CAPE COOK
KYUQUOT
ZEBALLOS
ESPERANZA INLET
NOOTKA
BAJO REEF
ESTEVAN POINT
RAFAEL POINT
TOFINO
LONG BEACH
UCLUELET
BARKLEY SOUND
BAMFIELD
PACHENA POINT
PORT SAN JUAN
CAPE FLATTERY
NEAH BAY
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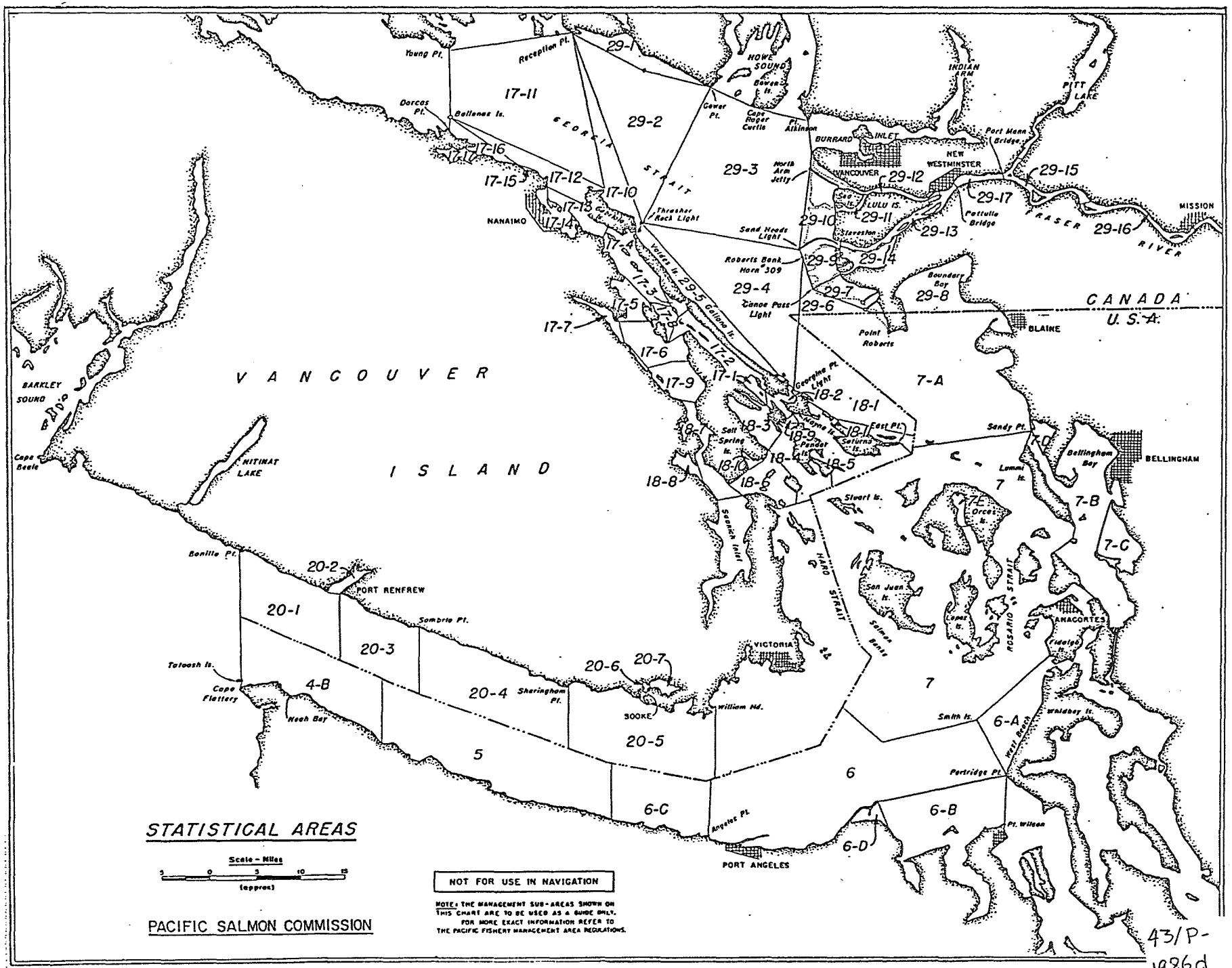
STATISTICAL AREAS
Scale – Miles
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(approx)
PACIFIC SALMON COMMISSION
NOT FOR USE IN NAVIGATION
NOTE: THE MANAGEMENT SUB-AREAS SHOWN ON THIS CHART ARE TO BE USED AS A GUIDE ONLY. FOR MORE EXACT INFORMATION REFER TO THE PACIFIC FISHERY MANAGEMENT AREA REGULATIONS.
VANCOUVER ISLAND
CANADA
U.S.A.
HOWE SOUND
GEORGIA STRAIT
JUAN DE FUCA STRAIT
HARO STRAIT
ROSARIO STRAIT
PUGET SOUND
NANAIMO
VICTORIA
SOOKE
PORT RENFREW
PORT ANGELES
BELLINGHAM
BLAINE
VANCOUVER
NEW WESTMINSTER
MISSION
ANACORTES
BARKLEY SOUND
NITINAT LAKE
FRASER RIVER
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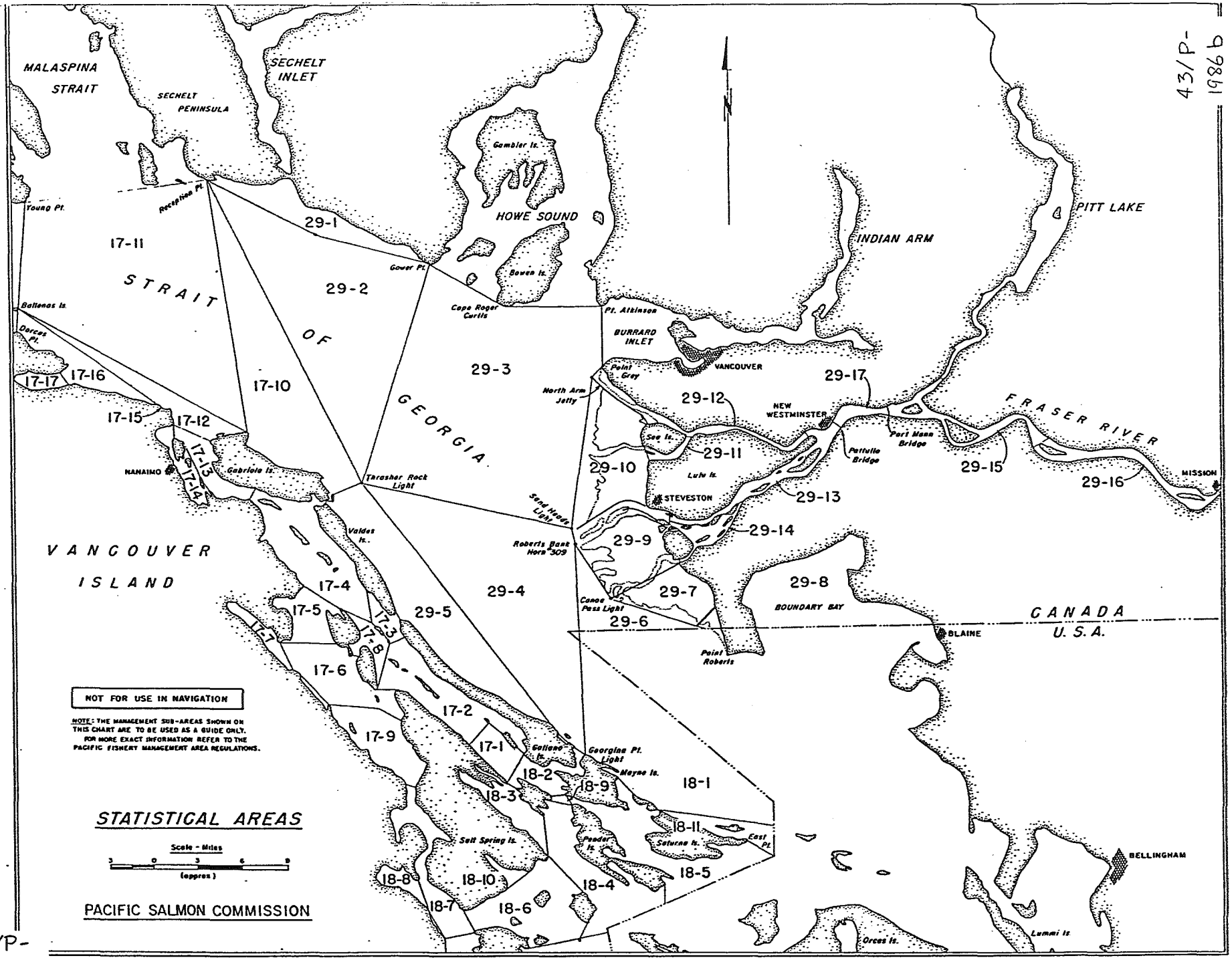
Young Pt.
Reception Pt.
Bowen Is.
Gower Pt.
Cape Roger Curtis
Pt. Atkinson
Dorcas Pt.
Ballenas Is.
Thrasher Rock Light
Entrance
Sand Heads Light
Roberts Bank Horn 309
Canoe Pass Light
Point Roberts
Boundary Bay
Georgina Pt. Light
Active Pass
Mayne Is.
Pandora Hill
Galiano Is.
Valdes Is.
Gabriola Is.
Salt Spring Is.
Saturna Is.
East Pt.
Sandy Pt.
Bellingham Bay
Lummi Is.
Stuart Is.
Orcas Is.
San Juan Is.
Lopez Is.
Shaw Is.
Fidalgo Is.
Waldron Is.
Smith Is.
Partridge Pt.
Pt. Wilson
Port Mann Bridge
Pattullo Bridge
Indian Arm
Pitt Lake
Burrard Inlet
North Arm Jetty
Lulu Is.
Sea Is.
Barnston Is.
Boundary Bay
Bonilla Pt.
Sombrio Pt.
Sheringham Pt.
William Hd.
Cape Flattery
Neah Bay
Tatoosh Is.
Angeles Pt.
Race Rocks
Swanson Inlet
Saanich Inlet
Haro Strait
Rosario Strait
Juan de Fuca Strait
Salmon Banks
West Beach
Cape Beale


MALASPINA STRAIT
SECHELT PENINSULA
SECHELT INLET
HOWE SOUND
Gambier Is.
PITT LAKE
INDIAN ARM
Young Pt.
Reception Pt.
Gower Pt.
Bowen Is.
Ballenas Is.
Dorcas Pt.
Cape Roger Curtis
Pt. Atkinson
BURRARD INLET
Point Grey
VANCOUVER
North Arm Jetty
See Is.
NEW WESTMINSTER
Port Mann Bridge
Pattullo Bridge
FRASER RIVER
MISSION
NANAIMO
Gabriola Is.
Thrasher Rock Light
Lulu Is.
STEVESTON
Sand Heads Light
Valdes Is.
Roberts Bank Horn
VANCOUVER ISLAND
Canoe Pass Light
BOUNDARY BAY
CANADA
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BLAINE
Point Roberts
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Galiano Is.
Georgina Pt. Light
Mayne Is.
Saltspring Is.
Pender Is.
Saturna Is.
East Pt.
BELLINGHAM
Orcas Is.
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STATISTICAL AREAS
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(approx.)
PACIFIC SALMON COMMISSION

43/P-1986

43/P-